APPENDIX A

EPA/ROD/R07-04/656
2004

EPA Superfund
Record of Decision:

ORONOGO-DUENWEG MINING BELT
EPA ID: MOD980686281
OU 01
JOPLIN, MO
09/30/2004

RECORD OF DECISION
DECLARATION

SITE NAME AND LOCATION

Oronogo/Duenweg Mining Belt Site, Operable Unit 1
Jasper County, Missouri

STATEMENT OF BASIS AND PURPOSE

The U.S. Environmental Protection Agency (EPA) has prepared this decision document to present the selected remedial action for mining and milling wastes at the Oronogo/Duenweg Mining Belt Site (Site) located in Jasper County, Missouri. This decision was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for this Site. The Administrative Record file is located in the following information repositories:

1. Joplin Public Library
   300 Main
   Joplin, Missouri

2. Webb City Public Library
   101 South Liberty
   Webb City, Missouri

3. Carl Junction City Hall
   105 North Main
   Carl Junction, Missouri

4. U. S. Environmental Protection Agency
   901 North 5th Street
   Kansas City, Kansas

The EPA has coordinated selection of this remedial action with the Missouri Department of Natural Resources (MDNR). The state of Missouri concurs on the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This selected remedy deals with the cleanup of mining and milling wastes, soil, and selected sediments contaminated with metals from past mining activities at the Site. This cleanup action is one part of the EPA's overall efforts under Superfund to deal with environmental contamination resulting from historic lead and zinc mining, milling, and smelting operations in Jasper County. Cleanup activities of metals contaminated residential yards and individual private water wells have already been implemented, and are nearly complete. This phased approach to the cleanup is being used for this Site in order to clean up the contamination which poses the greatest health threat first. The EPA believes that the selected remedy is consistent with previous cleanups that conducted at the Site.

The major components of the selected remedy are:

- Removal of mine/mill wastes, contaminated soil, and selected stream sediments
- Subaqueous disposal of excavated source material in mine subsidence pits
- Recontouring and revegetating excavated areas
- Plugging of selected mine shafts and surface water diversion from mine openings
- A monitoring program for assessing the effect of cleanup on Site streams
- Continuation of the Health Education Program established under OU 2/3
- Institutional controls to regulate future residential development in contaminated areas and the use of the disposal areas

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, is expected to comply with chemical-, location-, and action-specific federal and state requirements that are legally applicable or relevant and appropriate to the remedial, action, and is cost-effective. This remedy utilizes permanent solutions to the maximum extent practicable. Natural treatment of waste will occur after disposal to reduce the mobility of the metals contamination in the wastes.

Because this remedy will result in hazardous substances remaining on the Site above health-based levels, a review will be conducted within five years to ensure that the remedy continues to provide adequate protection of human health and the environment.

Cecilia Tapia, Director
Superfund Division
U.S. EPA, Region 7

3/30/04
Date

Record of Decision

ORONOGO-DUENWEG MINING BELT SITE
JASPER COUNTY SUPERFUND SITE
JASPER COUNTY, MISSOURI

MINE AND MILL WASTE
OPERABLE UNIT 1

Prepared by:

U.S. Environmental Protection Agency
Region VII
901 North 5th Street
Kansas City, Kansas 66101

September 2004

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1.0 Introduction

This Record of Decision (ROD) has been developed by the United States Environmental Protection Agency (EPA) to address the mine and mill waste in Operable Unit 1(OU-1) of the Oronogo-Duenweg Mining Belt site (also known as the Jasper County Superfund site) located in Jasper County and portions of Newton County, Missouri. This ROD is published in accordance with the requirements of Section 117 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also referred to as the Superfund Law), 42 U.S.C. §9617.

The EPA has coordinated the development of this ROD with the Missouri Department of Natural Resources (MDNR). The EPA is the lead agency and the MDNR is the support agency.

2.0 Purpose of the Record of Decision

The primary purpose of the ROD is to document the cleanup alternative selected by the EPA to address the metals contamination from past mining and milling operations at this site. The cleanup alternative presented in this ROD was selected by the EPA after review and assessment of comments received during the public comment period. Documents supporting this decision are included in the Administrative Record (AR). This ROD and supporting documents in the AR are available for review during normal business hours at the following locations:

1. Joplin Public Library
   300 Main
   Joplin, Missouri

2. Webb City Public Library
   101 South Liberty
   Webb City, Missouri

3. Carl Junction City Hall
   105 North Main
   Carl Junction, Missouri

4. U.S. Environmental Protection Agency
   Region VII Docket Room
   901 North 5th Street
   Kansas City, Kansas

3.0 Community Participation

The EPA issued the Proposed Plan for OU-1 on July 19, 2004, and provided a 30-day review and comment period opening on July 19, 2004, and closing on August 19, 2004. A public meeting to present the plan and receive comments was held August 3, 2004, in Matthews Hall at the Missouri Southern State University in Joplin, Missouri, from 7:00 pm to 8:30 pm. Included in this ROD is a responsiveness summary that addresses in writing the significant comments the EPA received from the public during the comment period.

4.0 Site Background Information

The Oronogo-Duenweg Mining Belt site (Site) is located in Jasper County and portions of Newton County, Missouri. The Site is a concern because of mining wastes on the surface which constituted a significant source of heavy metals contamination with potential for exposure to people and environmental receptors. Past mining and milling practices resulted in the contamination of surface soil, sediments, surface water, and groundwater in the shallow aquifer. The primary contaminants of concern are lead, cadmium, and zinc. The EPA listed the Site on the National Priorities List (NPL) in 1990. The NPL is a national list of superfund sites that prioritizes cleanups in order of the most serious contamination problems and greatest threats to human health and the environment. The Site includes the mining wastes in and around 11 former mining areas, or designated areas (DAs), located within about 270 square miles of Jasper and Newton Counties. The DAs include Snap, Neck/Alba, Thorns, Joplin, Oronogo/Duenweg, Carl Junction, Klondike, Iron Gates, Iron Gates Extension, Belleville, and Waco. A map of the DAs is shown on Figure 1.

The Site is part of the Tri-State Mining District, which encompasses approximately 2,500 square-miles in Missouri, Kansas, and Oklahoma. The district's historic lead and zinc production ranks as one of the highest in the world, with total ore production estimated to have been slightly more than 0.5 billion short tons. The Missouri portion of the district accounted for approximately 0.2 billion short tons of the ore production, of which approximately 80 percent was derived from Jasper County. Mining in the Site was conducted from about 1848 to 1968. The majority of the mining was by underground methods where the mined ore was hoisted from the underground workings and was treated at mills on the surface. At the mills, the crude ore was crushed and sized to minus 5/8 inch, and then concentrated using gravity separation processes, or froth-flotation after about 1920.

During the early years of mining, lead concentrates were smelted in a large number of crude log furnaces. Advances in smelter technology and increasing specialization by operators led to centralization, and by 1873 there were only 17 lead smelters in the Joplin area. By 1894, the number had decreased to three, and to one by the 1920s. Most zinc concentrates were shipped to smelters located outside the district in areas where fossil fuel was abundant, as the smelting of zinc required considerably more heat than lead.

Approximately 160 million short tons of crude ore were mined in the DAs of which approximately 5 percent was recovered as zinc/lead concentrates, leaving an estimated 150 million short tons of discarded mill waste on the surface. Approximately 93 percent of this material has since been removed for various commercial purposes. Volume estimates prepared during the 1992 Remedial Investigation (RI) of the mine and mill waste remaining on site are indicated in Table 1.

5.0 Scope and Role of the Cleanup Action

As mentioned in the previous section, the investigation and study of the Site includes the mining wastes in and around 11 former mining areas or DAs located within about 270 square miles of Jasper and Newton Counties. The EPA divided the Site into four Operable Units (OUs) for cleanup activities because of the multi-media nature of contamination. The OUs include OU-1, Mining and Milling Waste; OU-2, Smelter Waste Residential Yards; OU-3, Mine Waste Residential Yards; and OU-4, Groundwater. This ROD addresses OU-1 and includes those areas in and around the DAs where mining, milling, and smelter wastes are located.

A Site-wide investigation was conducted February-September 1993, collecting data primarily on mined materials, soils, surface water, groundwater, terrestrial and aquatic biota, land use and demography, air quality, and human food sources. The results of this sampling program were documented in the Site Characterization Memorandum. The RI, with expanded sections on surface water, groundwater, fate, and transport, was completed in 1995.

In 1993, the EPA commissioned CDM Federal Programs Corporation (CDM) to conduct site investigations and characterization of the Iron Gates, Belleville, and Klondike DAs. This investigation is reported in the Site Characterization Report. In December 1994, CDM was directed to investigate a fourth DA, the Iron Gates Extension. This DA is located north of Shoal Creek in Jasper and Newton Counties (Figure 1-1). The results of this investigation are reported in an Addendum to the Site Characterization Report. CDM's approach, as directed by the EPA, was to be patterned on the previously approved sampling and analysis plan used for the other seven DAs. Their investigative approach for the DAs was documented in a 1993 Sampling and Analysis Plan.

A Feasibility Study (FS) was completed in 2003. The FS combines the information about the nature and extent of contamination in and around the DAs described in the Site Characterization Reports and the investigations characterizing and evaluating the DAs. The FS developed alternatives for remedial action for the entire Site. Additional studies have been conducted by the EPA, the MDNR, and the Potentially Responsible Parties (PRPs) to assist in developing and supporting the alternatives in the FS. The EPA and the PRPs conducted a sub-aqueous disposal pilot study in. which approximately 58,000 cubic yards of tailings were disposed in a mine pit near Waco. This study showed an initial release of metals into the groundwater and within a short time later the metals concentrations became stable. In addition, metals were not significantly leached out of the tailings because they were disposed under water and capped. The MDNR performed a similar study near Webb City by filling a mine shaft with bedrock materials. Results from that study were similar to the Waco study. The EPA and the MDNR have performed several studies to assess the effectiveness of biosolids application on mining wastes in the Oronogo and Carterville areas. These studies have shown that biosolids application is effective at reducing metals toxicity and promoting plant growth. These studies are all included in the AR for the Site.

This ROD for OU-1, Mining and Milling Waste, is consistent with previous EPA decisions for this Site. OU-1 was initially established to address the ecological and human health risks associated with mining, milling, and smelter wastes in the nonresidential areas. Subsequently, other OUs were established to address the human health risks associated with drinking water sources and residential soils. The EPA prioritizes response actions based on the need to address human health risks first.

In July 2000, the EPA issued an Engineering Evaluation/Cost Analysis (EE/CA) to initiate cleanup actions for a portion of OU-1 in the Oronogo-Duenweg DA of the Site. The Missouri Department of Transportation (MDOT) informed the EPA of plans to construct a portion of Highway 249 through mining waste areas in that part of the Site. The EPA coordinated with MDOT on the plans and alignment of the route. Subsequently, the EE/CA was issued and this decision specifies to use approximately 600,000 cubic yards of mining waste for construction of the highway. Portions of the highway are complete and MDOT is awaiting federal and state highway funds to complete the project.

The EPA has already initiated or completed a series of remedial actions to address human health risks at this Site, as follows: OU-4, Groundwater, which provides a public water supply to replace private shallow aquifer drinking water wells; and OU-2/3, Residential Yards, which removed lead and cadmium contamination from about 2,600 residential yards. These OUs include institutional controls (ICs) to protect future residents. For example, OU-4 restricts future access to the shallow contaminated groundwater. The RODs for these OUs are available in the AR repositories for the Site.

The EPA's current priority under this ROD is to address the risks posed by mine and mill wastes. OU-1 is focused primarily on mitigating risks to aquatic and terrestrial life. Secondly, OU-1 contains engineering controls to protect future human health. This ROD addresses risks to future residents through reliable and permanent engineering controls that significantly reduce the need for ICs that have been administratively difficult to implement, but were required under OU-2/3. In addition, this ROD establishes cleanup action levels that protect terrestrial. life and human health from risks of exposure to metals contamination in mine and mill wastes.

The cleanup of mining and milling wastes under this ROD is needed to mitigate the principal threat for OU-1, which is the risks to aquatic and terrestrial ecosystems from exposures to mill wastes, soils, sediments, surface water and groundwater. The main component is to excavate and dispose of source materials in selected on-site mine subsidence pits that are suitable from an engineering perspective for subaqueous disposal. This same remedial component, excavation/disposal, is essential to provide long-term protection of human health from exposure to the mine and mill wastes. The selected remedy for OU-1 will significantly enhance the effectiveness of earlier OU remedies which relied on ICs to protect future residential development in mine and mill waste areas.

6.0 Site Characteristics

The Site is located in and around Joplin in southwest Missouri. Approximately 90,000 people live in the area. The climate is continental with moderate winters and long, hot summers. The annual precipitation is about 40 inches. All watersheds of the Site are within the Spring River drainage basin, a 2,600 square-mile basin in southwest Missouri, southeast Kansas, and northeast Oklahoma. The principal tributaries of the Spring River in the Site are the North Fork of the Spring River, Center Creek, Turkey Creek, Short Creek, and Shoal Creek which are typical Ozark streams where base flows are sustained by springs from limestone in the headwater areas.

Water quality in the Spring River and its tributaries is influenced by runoff and seepage from mill waste, sediment migration from mining source areas into the streams, runoff from agricultural and urban areas, and wastewater discharge. Surface water chemistry is influenced by groundwater from non-point and point sources, mine shafts, and mine subsidence pits. Water quality in the Spring River and its tributaries is regulated by the state of Missouri for various beneficial uses: 1) livestock watering, 2) irrigation, 3) protection of aquatic life, 4) drinking water supply, 5) whole body contact, 6) boating, and 7) industrial water supply.

All of the streams at the Site are impacted from the former mining activity, and exceed federal water quality criteria in many reaches. Site streams and tributaries drain into the Spring River. The Spring River flows southwest into Kansas and continues south into Oklahoma. Metal concentrations exceed Federal aquatic life criteria (ALCs) as they cross the state line into Kansas. Additionally, sediments in the streams down stream of mining impacted areas contain elevated metal concentrations.

Two major aquifers underlie the Site, the Mississippian age Springfield Plateau aquifer and the deeper Ozark aquifer. The two aquifers consist of fractured and karst limestone (upper aquifer) and dolomites (lower aquifer), with the addition of the Gunter Member sandstone in the deep aquifer, and are separated by a sequence of shale and limestone that yields little or no water to wells. This sequence of shale and limestone acts as an impermeable confining layer or semi-confining layer between the two aquifers. The shallow aquifer generally exhibits unconfined or water-table conditions except where Pennsylvanian age shale is present above the limestone. The shallow aquifer hosts the lead-zinc ores. Many private wells tap the shallow aquifer for drinking water and are contaminated with cadmium, lead, and zinc. While most public water supplies are drawn from the deep aquifer, and the city of Joplin uses Shoal Creek for a portion of its water supply.

Two types of wastes were generated during the past milling activities; coarser grained chat and fine-grained tailings. Chat and tailings from the Site contain various levels of lead, cadmium, and zinc, depending on the DA. Chat is a waste product from a tabling and jigging gravity separation process. Chat is composed of gravel-, sand-, and silt-sized siliceous chert and limestone fragments. It is relatively free draining with low moisture content between 3 to 6 percent at depth and lower near the surface, as would be expected from coarse-grained crushed rock. Approximately 5,000,000 cubic yards of chat are located in the Site.

Chat in Jasper County is, and has been, an important source of aggregate and is quarried from the piles as an unprocessed, pit-run material; or in some cases, it is washed and screened for sale as a specifically sized aggregate. Most chat is currently used as aggregate in asphalt and in various types of bituminous overlays, slurry seals, and seal coats for roads. Large volumes have been used in the construction of roads and highways, as the primary aggregate or as the base-coarse material. Some chat is used in the construction of parking lots and driveways in residential settings. The EPA discourages this particular use because of the possible human exposure to heavy metals contained in chat in residential or high-child use settings. Because of its extensive use in all types of road construction, the primary consumers of chat are county and state departments of transportation. The EPA has issued a widely circulated Fact Sheet, dated July 1995 and updated in February 2003, on the use and misuses of mine waste. This fact sheet states that use of chat in unconfined situations presents a risk of exposure to both people and the environment.

Three different types of fine-grained tailings, referred to collectively as tailings, were identified from review of mill and chat processing operations: 1) fines from the gravity separation process, 2) fines from the use of the froth flotation beneficiation process (after about 1920), and 3) fines produced from the washing and screening of chat for use as an aggregate. Tailings are typically 30-60 percent silt-sized, the remainder being fine to medium-sized sand. Due to finer grain size, tailings hold more moisture (20 to 30 percent) than chat. Metal content varies by DA, primarily due to the type of tailings that are present. However, metals concentrations in tailings are in general significantly higher than in chat. It is estimated that there are 363,791 cubic yards of tailings in the Site. Unlike chat, tailings are not generally used as aggregate; thus the volumes, estimated in 1995, are believed to be relatively accurate. However, the estimated volume may be low as some tailings are covered by chat, and these deposits are only discovered when the chat is removed. No tailings were identified in the Klondike, Belleville, Iron Gates, or Iron Gates Extension DAs.

7.0 Current and Potential Future Site Use

Land use in Jasper County is dominated by agriculture, with about 45 percent of the total acreage in row crops or grass pasture. Residential, urban, and commercial/industrial areas combined cover about 30 percent of the DA acreage. Uncultivated land is present along the creeks and river channels that frequently flood, along active and inactive railroad right-of-ways, and in mined areas. Deciduous woodlands generally dominate the uncultivated land.

The area around Joplin and the surrounding communities has, for the past several years, been experiencing tremendous growth and expansion. Vacant uncontaminated land, particularly in the Webb City area, is beginning to become scarce. The EPA has worked with four separate developers to ensure adequate steps are taken prior to residential construction to protect human health. The local county officials are reluctant to establish ICs to control development in this rural community. During 2004 alone, the EPA oversaw remedial actions by developers of eight multi-unit apartment buildings and about 100 single family homes on mine and mill waste contaminated lands. As uncontaminated properties become more and more scarce, development of mine and mill waste contaminated lands will increase.

The local leaders have developed a master plan for some portions of the county and the EPA addresses these planning efforts in this ROD. The "Jasper County, Missouri Route 249 Redevelopment Plan" anticipates controlled development in the corridor of the new Highway 249 presently under construction. This ROD adopts the master plan as an IC which addresses future human health risks by limiting residential developments to areas outside the highway corridor.

8.0 Summary of Site Risks

In general, the EPA has determined that the principal threat for OU-1 is the ecological risk to aquatic biota caused by surface water containing the contaminants of concern (COCs) in concentrations exceeding ALCs and potential risks to terrestrial vermivores that may be caused by ingesting metals from soils exceeding threshold criteria. Additionally, as stated in the previous section, developers continue to construct residential housing on contaminated land which, if not conducted properly by removing or covering contaminated soil, will result in unacceptable risk to people moving into these areas.

The purpose of this ROD, therefore, is to document the EPA's selected remedial actions to mitigate the unacceptable human and ecological risks. The objective is to achieve significant reductions in COC loadings to surface waters, reduce risks to terrestrial vermivores. Moreover, the objective is to rely on the engineering control components of this ROD to permanently protect future residents from the human health risks of exposure to mining and milling wastes. The actions presented in this ROD will help eliminate the need for ICs that have been required, but have been difficult for the EPA to establish and implement. The EPA has determined, as lead agency, that the selected remedy in this ROD is necessary to protect public health or welfare and the environment from actual or threatened releases of hazardous substances into the environment.

8.1 Human Health Risk Assessment

The EPA prepared a baseline risk assessment for human health in 1995. The risk assessment addresses exposure and metals toxicity, and summarizes both quantitative and qualitative risk. Estimated metal intakes were compared to toxicity values in order to characterize non-carcinogenic effects. For estimating carcinogenic effects, estimated intakes and chemical-specific dose-response data were used to calculate the probabilities of an individual developing cancer over a lifetime. Exposures to lead were assessed separately, through the use of the Integrated Exposure Uptake Biokinetic Model (IEUBK). The risk assessment identified potential health risks for children who live on and near mill wastes, particularly those who also consume backyard garden produce. Exposure to cadmium and lead in soils, mill wastes, and garden produce accounted for most of the numeric calculated health risk. The assessment showed an unacceptable risk for people living on. soils or mine waste with lead levels exceeding 800 ppm lead or 75 ppm cadmium. Remedial actions taken under OU-2/3 have addressed the current risk.

The risk assessment identified a future risk for people building new homes on mining waste areas where surface soil or the mining wastes that contain COCs that exceed the action levels. The ROD for OU-2/3 includes ICs to reduce the future risk, and specify that the local government should establish an environmental health ordinance to control residential development on undeveloped lands with mining and milling waste. The EPA has worked with the local government and encouraged development of such ordinances; however, no ordinances have been established. Since the RODs were issued in 1998, many residential developments have been built at the Site without protective ICs. The EPA has provided assistance to developers and oversight of construction in some developments to reduce human health risks. This ROD provides cleanup levels for contaminated soil and mine and mill waste to reduce the reliance on ICs.

8.2 Ecological Risk Assessment

The Baseline Ecological Risk Assessment (BERA) evaluated risk to aquatic and terrestrial systems in the Site. The BERA addresses risks to aquatic vegetation, aquatic invertebrates, and fish by comparing the maximum measured concentrations of cadmium, lead, and zinc to water quality criteria and standards and conservative toxicity criteria. As evaluated in the BERA, maximum dissolved COC concentrations in surface water exceed Missouri's Aquatic Life Criteria (ALCs) and the Federal Ambient Water Quality Criteria (WQC), and the maximum concentration of COCs in some stream and pond sediments exceed low and severe effect sediment toxicity criteria. Maximum dissolved COC concentrations in some streams and ponds exceed aquatic vegetation toxicity values.

Risks to soil function were addressed in the BERA by comparing soil COC concentrations to toxicity benchmarks from the literature for plants, earthworms, and soil microflora. Comparisons to phytotoxicity reference values indicate that most mine-impacted soils contain COCs at concentrations that could be expected to adversely affect plant growth.

Comparisons to conservative earthworm toxicity benchmarks in the BERA indicated that both mining-related and non-mining related soils contain COCs at concentrations that could be expected to adversely affect earthworm populations. A site-specific study compared soil and earthworm body-burden COC concentrations to a range of sub-lethal and lethal toxicity values. Some soil COC concentrations exceeded the toxicity benchmarks.

The BERA evaluated risk to terrestrial receptors by modeling exposures to specific feeding guilds within the terrestrial environment. Risks to terrestrial vertebrate populations and communities were evaluated by comparing the average daily dose to selected toxicity reference values. An addendum to the final BERA reevaluated risks to terrestrial vermivores and concluded that terrestrial vertebrates that consume earthworms in soils with elevated COC concentrations may experience adverse chronic effects.

A technical memorandum “Risk Management Considerations for Terrestrial Vermivores” identified risk management strategies and described how risk-based cadmium, lead, and zinc threshold criteria were developed. These criteria establish a level of protectiveness that will mitigate risks to terrestrial vertebrates as follows: lead at 804 ppm, cadmium at 41 ppm, and zinc at 6,424 ppm. In summary, the BERA and addendum, other studies, and technical memorandum indicate that ecological risk management at the Jasper County Site is driven by 1) exposure of aquatic biota to surface waters that contain cadmium, lead, and/or zinc concentrations that exceed ALCs and 2) exposure of terrestrial vermivores to earthworms in soils that exceed risk-based threshold criteria established for the Site. The actions evaluated in the FS do not address risk to terrestrial invertebrate populations or plants.

9.0 Remedial Action Objectives

The media-specific remedial action objectives (RAOs), developed in the FS to address the Site risks, are discussed in the following Sections:

9.1 Source Material RAO

The source material RAO has been designed to address the potential ecological risks associated with direct exposure to COCs in mine and mill wastes, and in the affected soils surrounding the wastes. Terrestrial vertebrates, specifically vermivores whose diet consists of earthworms and other soil-dwelling invertebrates, are identified as the receptors of concern based on information from the BERA. Ecological risks associated with source material erosion (as sediment) and seepage/runoff are addressed in other RAOs.

Exposure routes consist of ingestion of earthworms and other invertebrates in source materials and affected media with greater than 41 mg/kg cadmium, 804 mg/kg lead, or 6,424 mg/kg zinc that provide suitable habitat for site vermivores. Based on this exposure scenario, the source material RAO is as follows:

- Mitigate risks to terrestrial vermivores from exposure to COCs from mine, mill, and smelter wastes within the Site, such that the calculated toxicity quotients or hazard indexes are less than or equal to 1.0.

9.2 Sediment RAO

Sediments of concern in the Site consist of source materials that are eroded from source areas to waters bodies; Class P streams (as defined under Missouri’s water quality standards program), and their tributaries. Sediments represent a unique category of source materials that have been transported, or may be transported in the future, to aquatic environments where they potentially affect water quality and streambed substrate, thereby posing risks to aquatic biota. The exposure pathway of concern for the sediment RAO is the movement and redistribution of source materials that could result in exposure of aquatic biota to elevated COC concentrations. The COCs for sediments are cadmium, lead, and zinc. The sediment RAO for OU-1 is as follows:

- Mitigate risks to aquatic biota in Class P streams and their tributaries exceeding Federal ALCs for the COCs by controlling the transport of mine, mill, and smelter wastes from source areas to waters of the state.

9.3 Surface Water RAOs

Two RAOs have been developed that address two different pathways of exposure to aquatic biota. The first exposure pathway of concern is the transport of COCs to Class P streams and their tributaries resulting from seepage and runoff (dissolved and particulate metals) from source materials. The second exposure pathway involves the transport of COCs to Class P streams and their tributaries resulting from mine pit and pond discharges. The criteria for Class P streams and their tributaries are the Federal ALCs, as calculated based on the hardness observed in the individual surface water bodies. The RAOs for OU-1 surface water are as follows:

- Mitigate exposure of aquatic biota to COCs released and transported from mine and mill wastes where surface water applicable or relevant and appropriate requirements (ARARs) are exceeded in Class P streams and in tributaries.

- Mitigate exposure of aquatic biota to COCs released and transported from Site mine-related pits and ponds where surface water ARARs are exceeded in Class P streams and in tributaries.

9.4 Groundwater RAO

The groundwater RAO addresses exposure of aquatic biota to COCs in Class P streams that receive discharge from flowing mine openings (e.g., mine shafts, vents, subsidence pits, etc.). The contaminant criteria are Federal ALCs. The COCs for OU-1 groundwater are cadmium, lead, and zinc. The RAO for OU-1 groundwater is as follows:

- Mitigate exposure of aquatic biota to COCs in releases of groundwater from flowing mine shafts of the Site where surface water ARARs are exceeded in Class P streams and in tributaries.

The groundwater RAO for this OU is limited to protecting the surface water from groundwater impacts due to flowing mine shafts. The RAO of mitigating human health risks from exposure to the contaminated shallow aquifer was addressed in OU-4, Groundwater, which provides an alternate public water supply to residents and establishes

ICs to mitigate the future risks of drilling new drinking water wells in the shallow aquifer. The Missouri Well Drillers law and regulations control shallow and deep aquifer well drilling in the Jasper and Newton County areas to reduce the risk that residents might use the contaminated shallow aquifer. The ROD for OU-4 determined that it is technically impractical for the Agency to remediate the shallow aquifer to achieve compliance with chemical-specific ARARs for drinking water sources. The EPA determined that it is not technically feasible from an engineering perspective to remediate groundwater because of the wide spread nature of contamination throughout the shallow aquifer, karst conditions, and interconnectedness of the mine workings within the shallow aquifer. Although contaminated groundwater seeps into surface waters and contributes some contaminants of concern, the groundwater RAO for this OU addresses only specific groundwater source where remediation is technically feasible, such as the flowing mine shafts, because of the technical impracticability of cleaning up the entire shallow aquifer to meet maximum contaminant levels for drinking water.

10.0 Development of Cleanup Levels

Cleanup criteria to protect terrestrial organisms were developed during the Remedial Investigation/Feasibility Study process as documented in the technical memorandum “Risk Management Considerations for Terrestrial Vermivores”. Based on the findings in that document, the EPA is selecting cleanup criteria to protect the terrestrial environment of 800 ppm lead, 40 ppm cadmium, and 6,400 ppm zinc.

The ROD for OU 2/3 established action levels for protection of human health at 800 ppm lead, and 75 ppm cadmium (25 ppm cadmium. in existing gardens). No zinc level was established because zinc in soil has not been determined to cause a risk to people. The action levels were based on discrete samples collected in individual residential yards, where the highest recorded discrete sample was used to trigger a cleanup action for the yard. Once an action was triggered in a yard, all soil exceeding 500 ppm lead was removed to a maximum depth of 12 inches. Analyses performed by the EPA of the more than 50,000 samples collected during the OU 2/3 action indicates that the single highest sample for a yard of 800 ppm lead, generally translated to a yard average lead concentration of 400 ppm. OU 2/3 actions, as stated, were triggered based on single highest sample results. Subsequently, the EPA has released new guidance stating that residential cleanup actions should be based on yard average concentrations. Using the yard average method of determining cleanup action generally results in lower action levels than using the single highest value, or “hot spot” method to achieve equal protectiveness. Additionally, the EPA guidance established 400 ppm lead as a screening level for site, below which cleanup actions are generally not warranted. The 400 ppm lead value established in the EPA guidance is considered to be protective of young children. Therefore, the EPA has determined that protection of human health at this Site requires the cleanup of source materials at action levels of, at least, 400 ppm lead and 75 ppm cadmium.

Obviously, the human health and terrestrial criteria differ with respect to cleanup levels. Therefore, the selected remedy uses the most conservative value between the two sets of criteria as the overall action levels for the Site to protect both future human health and the terrestrial environment. The action levels for source materials and contaminated soils will be 400 ppm lead, 40 ppm cadmium, and 6,400 ppm zinc.

Numeric action levels for source material for protection of the aquatic environment are not being established in this ROD. Aquatic sediment criteria are generally much lower than the concentrations found in the Site source materials. Any source material eroding into streams is considered to create unacceptable risk to aquatic organisms. Therefore, action criteria for source material to protect the aquatic environment are strictly visual, in that any source material eroding, or with high potential to erode to streams and their tributaries will be removed and disposed.

11.0 Summary of Alternative Cleanup Plans Evaluated

The EPA developed and evaluated six alternatives during the FS. The no action alternative also was evaluated, however, the EPA believes that the no action alternative is not protective of ecological health and does not consider it a viable option. The no action alternative and the five action alternatives are described below. Additionally, each of the alternatives will require, to varying degrees, ICs to protect and augment the remedy. The types of ICs that may be included with the remedies are described at the end of this section.

11.1 Remedial Alternatives

The following six remedial alternatives were developed in the FS

Alternative 1: No Further Action – This alternative prescribes no new remedial actions but recognizes and takes into consideration the engineering actions, rules, regulations, ICs, and cultural and land use practices that are currently ongoing or are planned to be performed or implemented, such as the removal and remediation actions and ICs being implemented under OU-2/3, OU-4, the Highway 249 project conducted by the MDOT, and ongoing chat recycling. Cost of this alternative is estimated at $291,000 for continuation of the ICs for 30 years. Waste reduction or containment would be zero.

Alternative 2: Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling – This alternative is a comprehensive alternative that pairs early response actions with long-term containment and on-going recycling. The initial response actions would remove source materials from the floodplains and tributary channels and consolidate these materials in on-site ‘waste containment cells. Long-term actions include the use of biosolids to treat, revegetate, and stabilize the consolidated mill wastes, as well as the unconsolidated upland mill waste deposits that remain on site. These long-term treatment and containment actions are designed to reduce metal loadings to surface water, sediment transport, and risks to terrestrial vermivores. This alternative recognizes chat recycling as an ongoing cultural practice and, by establishing ICs, addresses the inadequacies of current uncontrolled recycling to eventually diminish the amount of untreated and un-contained mill wastes that are subject to runoff and erosion and addresses all chat after 30 years. ICs are designed to regulate chat recycling, end uses for recycled chat, and post-recycling land remediation. Cost of this alternative is estimated at $44,312,000 for remedial action and continuation of the ICs with annual operation and maintenance (O&M) of $101,000. Waste reduction or containment would be 84 percent.

Alternative 3: Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegetation, and Recycling – The initial response actions are essentially the same under this alternative as under Alternative 2. However, instead of using biosolids applications, this alternative reduces the timeframe to 12 years for remedial actions by using simple vegetated soil covers to contain the consolidated mill wastes, as well as unconsolidated upland mill waste deposits remaining on site. Under this alternative, chat recycling is recognized as an ongoing practice that reduces the volume of mill wastes subject to runoff and erosion and addresses all chat after remediation of other source materials. ICs for chat recycling are the same as Alternative 2. Cost of this alternative is estimated at $77,112,000 for remedial action and continuation of the ICs with annual O&M of $83,600. Waste reduction or containment would be 80 percent.

Alternative 4: Source Removal and Disposal in On-Site Subsidence Pits – This alternative emphasizes the excavation and disposal of source materials in selected on-site subsidence pits that provide a suitable environment for subaqueous mill waste disposal. This alternative prescribes the excavation and disposal of more source materials than either Alternatives 2 or 3, and retains limited opportunities for ongoing chat recycling with the same ICs. The time-frame needed to excavate and dispose of source materials in subsidence pits is estimated at five years. Cost of this alternative is estimated at $58,543,000 for remedial action and continuation of the ICs with annual O&M of $22,500. Waste reduction or containment would be 90 percent.

Alternative 5a: Source Removal and On-Site Disposal in Aboveground Repositories – Alternative 5a prescribes the same degree of excavation and disposal as Alternative 4. However, instead of disposing of the mill wastes in on-site subsidence pits, the wastes are consolidated and disposed in aboveground repositories with geo-composite soil covers designed to nearly eliminate infiltration and seepage. As under Alternative 4, opportunities for ongoing chat recycling are included. Cost of this alternative is estimated at $93,707,000 for remedial action and continuation of the ICs with annual O&M of $137,000. Waste reduction or containment would be 90 percent.

Alternative 5b: Source Removal and On-Site Disposal in Centralized, Aboveground Repositories and Limited Water Treatment – This alternative is called Alternative 5b because it shares similarities with Alternative 5a in terms of its reliance on excavation and disposal of mill wastes in on-site aboveground repositories. However, this alternative is more aggressive in the amount of mill wastes that are disposed and in the degree of consolidation through the use of centralized repositories. In addition, Alternative 5b couples on-site disposal with passive anaerobic treatment systems to treat the discharges from selected mine openings. Cost of this alternative is estimated at $81,296,000 for remedial action and continuation of the ICs with annual O&M of $102,000. Waste reduction or containment would be 100 percent.

11.2 Source Material Institutional Controls

This section provides information on ICs that were developed to augment the alternative cleanup plans evaluated in the FS. Selected ICs are included in this ROD to enhance and protect the engineering controls in the selected alternative (described in Section 13). ICs are defined as non-engineered access or land use restrictions designed to reduce or prevent residual human health or ecological risks that may remain following the implementation of engineered remedial actions at CERCLA sites. ICs may be useful for controlling human and environmental exposures and improving long-term protectiveness of engineering controls.

The active cleanup plans, Alternatives 2, 3, 4, 5a and 5b, evaluated in the FS include an IC to reduce the exposure risks to human health and the environment from chat recycling activities. The IC considered was to enter into legal agreements with individual owners/operators of chat recycling operations. This IC was developed to regulate chat recycling, end uses for recycled chat, and post-recycling land remediation, and is described in detail in the FS under Alternative 2.

Two general types of ICs were considered in the FS and are proposed to supplement the engineering components of the preferred alternative. In general, the ICs proposed for the preferred alternative should be adopted by a governing body and can be subject to amendment in the future. However, some of the proposed ICs can be established by land use controls under state property laws. The two types of ICs proposed to control source materials that would be disposed or capped on site under the preferred alternative are land use restrictions and access control, and land use regulations and health codes to protect human health.

12.0 Summary of the Comparative Analysis of Alternatives

The National Contingency Plan (NCP), 40 CFR Section 300, requires the EPA to evaluate remedial alternatives against nine criteria to determine which alternative is preferred. The EPA performs this analysis during the FS. The detailed analysis in the FS Report provides an in-depth analysis of the six alternatives compared against the nine criteria. An alternative must satisfy all nine criteria before it can be selected. The first step is to meet the threshold criteria, which are overall protection of public health and the environment and compliance with ARARs. In general, alternatives that do not satisfy these two criteria are rejected.

The second step is to compare the alternatives against a set of balancing criteria. The NCP establishes five balancing criteria which include long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; implementability; short-term effectiveness; and cost. The third and final step is to evaluate the alternatives on the basis of modifying criteria, which are state and community acceptance.

12.1 Threshold Criteria

The following presents a brief description of how the alternatives satisfy the threshold criteria of overall protection of public health and the environment and compliance with ARARs.

12.1.1 Overall Protection of Human Health and the Environment

This criterion provides an overall assessment of whether an alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors from other criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. A comparative analysis of the remedial alternatives with respect to the overall protection of human health and the environment is given in Table 2.

Alternatives 2, 3, 4, 5a, and 5b will protect the environment to varying degrees. Because of the continued risks to aquatic and terrestrial biota, Alternative 1 (No Further Action) is not considered protective of the environment. None of the RAOs identified for OU-l are consistently met under this alternative. Some or all of the residual wastes will exceed the threshold criteria for vermivores and continue to pose wildlife exposure issues for an indefinite time period.

Alternative 2 provides protection of the aquatic environment through early response actions coupled with interim and long-term actions, such as long-term recycling, designed to address the surface water and sediment RAOs. The surface water RAOs may not be met in all Class P streams all the time because the long-term surface water actions prescribed under Alternative 2 may not be completely effective or reliable in meeting ALCs under all flow conditions. Alternative 2 may not be fully protective of aquatic life in the unclassified tributaries in the near future because the federal chronic ALCs would continue to be exceeded under most flow conditions and the surface water RAOs would fail to be achieved. However, Alternative 2 would likely achieve protectiveness in the tributaries over a very long time frame, i.e., centuries. Although the main actions addressing surface water would occur within the first few years, the time frame for full implementation of the surface water actions is very long, on the order of 30 years. The time estimated to complete Alternative 2 is based on estimated availability of biosolids from known sources of wastewater treatment plant sludges. If sources of supplies for biosolids included additional wastewater treatment plants, composted poultry or other animal waste, the time frame could be significantly shortened.

Alternative 2 addresses the source material RAO primarily by deep tilling vegetated chat and transition zone soils to reduce metals concentrations below the threshold criteria for vermivores, and might provide a treatment effect to reduce toxicity of the residual metals. With regard to vegetated chat and transition soils, risks to terrestrial vermivores, such as the short-tailed shrew and American Woodcock are low. However, Alternative 2 also relies heavily on ICs, for at least 30 years, to control chat recycling, which offers significantly less permanent and less effective overall protection of human health and the environment compared to the active engineering controls in Alternative 4, which may permanently contain source materials. Although the ICs described in the 1998 Selected Remedy for OU-2/3 provide limited protection for residential development, these controls are not effective unless the local government enacts land use controls, which has not occurred. Thus, Alternatives 2 and 3 rely on IC components to reduce risk from recycling chat and are not as protective as Alternatives 4, 5(a) and 5(b), that use engineering controls to contain source materials.

The groundwater RAO is addressed under Alternative 2 by engineering actions designed to reduce the amount of surface water captured by open mine shafts. These actions include plugging selected mine shafts and diverting surface flows away from open shafts, collapsed shafts, subsidence pits, and other features that connect the surface water regimes to the shallow aquifer.

Alternative 3 relies on early response actions with long-term containment and on-going recycling. It would be protective of aquatic resources by addressing the principal surface water threats in the Site through the initial source consolidation actions aimed at addressing surface water and sediment RAOs. However, like Alternative 2, Alternative 3 may not be fully protective of aquatic life in the tributaries in the near term because the federal chronic ALCs would continue to be exceeded under some flow conditions and the surface water RAOs would fail to be met. Alternative 3 would likely achieve protectiveness in the tributaries over a very long time frame, i.e., centuries. The use of simple soil covers would allow an aggressive schedule for addressing the RAOs (12 years). The source materials RAOs are addressed under Alternative 3 by consolidating and capping tailings, barren chat, in- and near-stream vegetated chat, and vegetated chat sediment sources with simple soil covers. In addition, upland vegetated chat and transition zone soils are deep tilled to reduce metal concentrations below threshold criteria for terrestrial vermivores. These engineering actions are expected to achieve the source material RAOs at full implementation.

In Alternative 3 the groundwater RAO is addressed by engineering actions designed to reduce the amount of surface water captured by open mine shafts, such as plugging certain selected mine shafts and diverting surface flows away from open shafts and subsidence pits.

These actions are deemed adequate for addressing the groundwater RAO by further reducing metal loads to surface waters, although groundwater discharge to surface water does not drive ALC exceedances under current conditions.

Alternative 4 would be protective of human health and the environment by nearly eliminating the transport and exposure pathways associated with surficial mill waste deposits. Alternative 4 is expected to be capable of achieving the metal loading reductions needed to meet the surface water RAOs in the Class P streams soon after completion of the remedial actions and in the tributaries in a relatively short time frame thereafter, i.e., decades. Therefore, Alternative 4 would meet the surface water RAOs and be protective of aquatic life. Modeling and demonstration project results indicate that disposing of mill wastes in subsidence pits may result in a short-term local release of metals to groundwater. However, the release of metals was observed to be temporary, local in nature, and is expected to have a minor impact on surface water quality. In the long term, groundwater quality is expected to improve relative to current conditions because the flux of atmospheric oxygen and oxygenated surface water into the mine workings will be locally reduced. Hence, the groundwater RAO is expected to be addressed through long-term and permanent improvement in groundwater quality.

Alternative 5a will be protective of human health and the environment. The source materials, surface water, and sediment RAOs would be achieved in an aggressive timeframe, approximately seven years. Compared with current conditions, aboveground disposal of source materials will significantly reduce surface water loadings from mining related sources because surface runoff and sediment transport to Class P streams and their tributaries are nearly eliminated. Therefore, Alternative 5a would be protective of aquatic life.

Alternative 5b would be fully protective of human health and the environment because all source materials would be effectively isolated from human and environmental receptors and prevented from interacting with other media. Source material, surface water, and sediment RAOs would be achieved in a relatively short timeframe (five years). Metal loadings to Class P streams and their tributaries are expected to be nearly eliminated by excavating all source materials and sediments containing mill wastes, disposing of the wastes in secure, aboveground repositories, and reclaiming the excavated areas. Therefore, Alternative 5b would be protective of aquatic life.

12.1.2 Compliance With ARARs

This criterion is used to decide how each alternative meets federal and state ARARs, as defined in CERCLA Section 121. Compliance is judged with respect to chemical-specific, action-specific, and location-specific ARARs as well as appropriate criteria, advisories and guidance to be considered (TBCs). A list of ARARs identified for each alternative is in the FS report. A comparative analysis of remedial alternatives with respect to compliance with ARARs is given in Table 3.

Chemical-Specific ARARs

A list of federal and state chemical-specific ARARs is given in Table 4. A principle risk addressed in this ROD is the exposure of aquatic life from contaminants of concern in surface waters. The principle chemical-specific ARARs that the preferred alternative must comply with are the standards and criteria established under the CWA for protection of aquatic life. These standards are established by the EPA and state and tribal governments pursuant to CWA regulations at 40 CFR Part 131.

The identification of chemical-specific ARARs for surface water in the Jasper County Site is complex because divergent federal and state water quality standards and criteria exist, the existing state criteria are currently being reevaluated, and opportunities exist for developing site-specific criteria. The EPA does not consider the current Missouri WQC to be protective of aquatic life, for example, in the unclassified streams, such as the tributaries to designated perennial (Class P) streams. To address the EPA's concerns about the possible lack of state-wide protectiveness, Missouri's Water Pollution Control Program is currently in the process of revising the state's WQC. Preliminary work performed by the state indicates Missouri's revised WQC will likely be similar to current Federal standards. Although Missouri's WQC may be relevant and appropriate chemical-specific requirements for surface waters within the Jasper County Site, presently, the federal criteria are more stringent and more protective. Thus, the remedial alternatives must comply with the federal criteria under CWA regulations. When Missouri's revised WQC are promulgated, it is anticipated that the EPA will consider them to be protective, and they may become the relevant and appropriate requirements in the future as the EPA conducts five-year reviews of the remedy selected for OU-1.

In addition, the federal chronic ALCs are also considered relevant and appropriate requirements for Class P streams within the Jasper County Site because the Class P streams identified as part of the remedial actions flow into Kansas, and Kansas has adopted the federal chronic ALCs for the streams into which the Site's Class P streams flow. In the Class P streams and their tributaries, the federal chronic ALCs are considered relevant and appropriate for purposes of the comparative analysis of compliance with ARARs.

Alternative 1, the No Further action alternative, represents a continuation of current conditions. Under current conditions, periodic exceedances of surface water ARARs are expected to occur in Class P streams and more commonly in their tributaries. Although surface water quality is expected to gradually improve due to the continued reduction in chat volumes through recycling, Alternative 1 is not expected to consistently comply with the surface water ARARs.

Alternatives 2 and 3 may not be capable of achieving the greater than 90 percent reductions in zinc loads needed to comply with federal ALCs in all Class P stream segments and their tributaries under all flow conditions. Chemical-specific ARARs for surface water are expected to be consistently met by Alternatives 4, 5a, and 5b. In addition, Alternatives 4, 5a, and 5b will result in compliance with the surface water ARARs in a relatively short timeframe, 5 to 7 years. However, monitoring of Alternative 4 will be necessary to assess any short-term increase in metal concentrations in surface water or drinking water wells.

Action-Specific ARARs

All of the candidate alternatives are equally capable of meeting the action-specific ARARs identified for the individual alternatives. A list of federal and state action-specific ARARs is given in Table 5.

Location-Specific ARARs

All of the candidate alternatives are equally capable of meeting the location-specific ARARs identified for the individual alternatives. A list of federal, state, and local location-specific ARARs is given in Table 6.

To Be Considered

Alternatives 1 and 2 are not expected to comply with the threshold criteria for terrestrial vermivores, as vegetated mill wastes will be left on site that will likely exceed the criteria. Under Alternative 2, biosolids applications alone, without deep tilling or soil amendment, are not expected to reduce total metals levels below the threshold criteria. All other alternatives are expected to comply with the total metal-based criteria.

The EPA's probable effect concentrations and equilibrium partitioning sediment guidelines are identified in Table 4 as chemical-specific TBCs for Site sediments. It is uncertain if these TBCs would be achieved under any of the candidate alternatives. However, with time, the COC concentrations in sediments should approach background levels under all the action alternatives.

12.2 Balancing Criteria

The following presents a brief description of how the alternatives developed in the FS satisfy the balancing criteria.

12.2.1 Long-Term Effectiveness

This criterion addresses the results of a cleanup action in terms of the risk remaining at the Site after the goals of the cleanup have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. A comparative analysis of remedial alternatives with respect to long-term effectiveness and permanence is given in Table 7.

Magnitude of Residual Risks

The volume and acreage of mill waste left on Site and the engineering controls prescribed for stabilizing or containing the wastes at full implementation provides a means of comparing the magnitude of residual risks under each of the remedial alternatives. Alternative 1 provides no engineering controls to manage the residual risks associated with approximately 5,000 acres of land affected by mill wastes. Under Alternative 1, residual risks to terrestrial vermivores and aquatic biota would remain at or near current levels; Alternative 2 would result in less affected lands and would manage the residual risks. Of the action alternatives, Alternative 3 would result in the greatest land area affected by mill waste and the residual risks would be the highest of the action Alternatives. The magnitude of residual risks is potentially low under Alternative 4 because source materials are permanently disposed underground. The footprints of the filled subsidence pits, and the biosolids treated areas will require long-term protection to manage residual risks. Groundwater monitoring is also necessary for managing and assessing residual risks over time. The residual risks under Alternative 5a would be essentially the same as under Alternative 4, except that the area occupied by permanent waste repositories is larger under Alternative 5a, and Alternative 4 requires groundwater monitoring. Under Alternative 5b even less affected lands would remain. Based on the above evaluation, the magnitude of residual risks is lowest under Alternatives 4, 5a, and 5b.

Adequacy and Reliability of Engineering Controls

The comparison of alternatives with respect to the adequacy and reliability of controls is based on a variety of factors, such as treatability testing results, technology literature reviews, modeling results, and engineering judgement.

Under Alternative 1, mill wastes are left on Site with no vegetation or engineered cover systems. Leaving source materials uncovered and unvegetated is not adequate or reliable for preventing risks to aquatic life. Alternative 1 does not address risks to terrestrial vermivores because a large volume of wastes will remain that exceed the threshold criteria for vermivores.

Direct vegetation, as prescribed under Alternative 2, may be only partially adequate for reducing seepage and metal loadings to surface water, even though the use of biosolids provides a treatment effect on the metals in the wastes. From an engineering perspective, the direct revegetation of source materials prescribed under Alternative 2 is considered the least permanent or reliable of the cover systems proposed under the action alternatives.

The simple soil covers prescribed under Alternative 3 more adequately and reliably reduce infiltration and seepage. Although Alternative 3 is an improvement over Alternatives 2, Alternative 3 is only partially adequate for reducing seepage, metal loadings to surface water, and risks to aquatic life. Alternative 3 is adequate and reliable for addressing risks to terrestrial vermivores.

Excavation of source materials and disposal in subsidence pits, as described under Alternative 4, represents the most permanent and reliable method of meeting the RAOs pending successful monitoring of groundwater over time. This alternative permanently contains the source materials in pits which prevents direct contact exposures for terrestrial life and humans, and significantly reduces the need to rely on previously planned, but less reliable, ICs to reduce human health risks from direct contact with the source materials. By removing the source materials from the flood plains and erodible areas and containing it in disposal pits, Alternative 4 permanently eliminates runoff and infiltration due to the source material waste piles from contaminating surface waters.

Alternatives 5a and 5b are highly effective known technologies. Alternative 4 is somewhat more reliable and permanent because source materials are disposed underground, instead of aboveground. Although the prescribed repositories in 5a and 5b are secure, they would require perpetual maintenance and ICs to prevent disturbance over a larger area compared to the maintenance that will be require by Alternative 4, due to the type of waste caps involved and the acres of disposal area.

12.2.2 Short-Term Effectiveness

This criterion addresses the effects of the alternative during the construction until the cleanup is completed and the selected level of protection has been achieved. A comparative analysis of remedial alternatives with respect to short-term effectiveness is given in Table 8.

Risks to the Local Communities and Workers

Potential risks to local communities during remedial actions are similar under all candidate alternatives. The conventional risks posed by earthmoving and construction activities are readily mitigated through engineering controls, safety training, and public involvement efforts. Potential risk to workers during remedial actions is similar under all of the action alternatives.

Potential Environmental Impacts

The implementation of the action alternatives may result in environmental impacts, including potential nitrogen and phosphorus loading to surface water, depletion of non-renewable soil resources, and degradation of riparian and aquatic habitat.

Improper or excessive biosolids applications could result in impacts to surface waters caused by increased nitrogen and phosphorus. Alternatives 2 and 3 rely most heavily on biosolids applications to achieve the RAOs, and the potential environmental impacts are a particular concern under these two alternatives. Under Alternative 3, several hundred acres of mill waste will be capped with soils. Alternative 4 also relies on biosolids application, but to a much lesser degree than Alternatives 2 and 3. During the early stages of revegetation, these capped areas will be susceptible to erosion. Local streams could receive elevated sediment loads during rainfall events.

The depletion of non-renewable soil resources is a potential environmental concern. Alternative 2 relies on borrow soil the least. Alternatives 4 and 5b rely on borrow soils much less than Alternatives 3 and 5a, and soil depletion is not expected to result in significant environmental impacts under Alternatives 4 and 5b.

Placement of mining wastes in the pits under Alternative 4 could result in short-term increases in metals concentrations to groundwater which may threaten nearby wells and surface waters if disposal pits are located near water wells or surface waters. Locating pits in these areas will be avoided to the extent practical and monitoring groundwater chemistry will identify increases in metals concentrations.

Removing sediments from stream channels, riparian areas, and wetlands may damage sensitive aquatic ecosystems. Proper timing of sediment removal activities will minimize this damage. These environmental risks are similar under each alternative except Alternative 1, which does not involve sediment excavation.

Based on the above evaluation, the actions prescribed under Alternatives 4 and 5b have the least potential for environmental impacts.

Time Until RAOs Are Achieved

Alternative 2 requires significantly longer time to implement than other alternatives due to the limited supply of biosolids available within a reasonable distance from the Site. If additional sources of biosolids, such as poultry litter, are available, the time frame required to implement Alternative 2 could be shortened. The timeframe required to implement Alternative 3 is intermediate between Alternative 2 and Alternatives 4, 5a, and 5b. At full implementation, the surface water and source material RAOs may not be fully achieved under Alternatives 1, 2 and 3. RAOs are achieved under Alternatives 4, 5a, and 5b in approximately the same time frame, between 5 to 7 years.

12.2.3 Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility or volume (TMV) of the contaminants. A comparative analysis of remedial alternatives with respect to reduction of toxicity, mobility, or volume through treatment is given in Table 9.

Alternatives 2, 4, and 5b are the alternatives expected to achieve TMV reduction. Alternative 2 incorporates application of biosolids, which may provide some treatment and stabilization of the metals. Under Alternative 4, subaqueous mill waste disposal is expected to result in remineralization of metal oxides as insoluble sulfides, thereby reducing the mobility of the metals. This method of treatment would be permanent and irreversible unless the mill wastes were removed from subsidence pits and exposed to oxidizing conditions. Under Alternative 5b, the only treatment occurs in passive anaerobic wetland treatment systems as sulfate-reducing bacteria remineralize metal oxides to insoluble sulfide forms, thereby reducing metals mobility. The concentration of metal in the waters treated by the passive anaerobic treatment systems is minor compared to the metal contained within source materials, thus treatment volumes under Alternative 5b are considered negligible.

12.2.4 Implementability

This criterion addresses the technical and administrative feasibility of implementing a cleanup and the availability of various services and materials required during its implementation. All the alternatives are readily constructable. However, the passive anaerobic treatment systems prescribed under Alternative 5b are innovative and few large-scale systems have been constructed. A comparative analysis of remedial alternatives with respect to implementability is given in Table 10.

The implementation of all the action alternatives will require varying degrees of coordination between the EPA, state and local agencies, landowners, and chat recyclers. Under any circumstance, administrative implementability is expected to be complicated by the fact that none of the parties that would be implementing the remediation own the lands that would be involved in the remedy.

Alternative 1 requires no materials to implement. The availability of biosolids and borrow soils affects the implementability of the action alternatives. Because of the limited supply of biosolids available within a reasonable distance from the Site, the timeframe for implementing Alternative 2 depends on the amount of biosolids used. The timeframe for implementing Alternative 2 may be relatively long (up to 30 years) due to the large volume of biosolids needed to implement the alternative and the availability of the biosolids. However, the use of poultry litter or other biosolid sources may shorten this timeframe. Alternative 3 relies less on biosolids applications and can, therefore, be implemented in a shorter timeframe (12 years). The timeframes for Alternative 4 (7 years), 5a (7 years), and 5b (5 years) are not dependent on biosolids applications because these alternatives use significantly less biosolids than Alternatives 2 and 3.

Alternative 2 uses no borrow soils. However, when simple soil covers are prescribed instead of biosolids applications under Alternative 3, a very large amount of borrow soil is used to accomplish approximately the same level of waste containment. The extremely large volume of soil needed to implement Alternative 3 may preclude its selection as a preferred alternative because the non-renewable soil resources of Jasper County may be depleted.

Alternatives relying on ICs to regulate chat recycling are not readily implementable. The administrative inefficiencies in developing and implementing legal agreements may preclude selection of such ICs as a component of the preferred alternative because of the required level of coordination with chat owners/operators and the required operation and maintenance of chat recycling which state and local officials would need to perform.

12.2.5 Cost Effectiveness

This criterion addresses the direct and indirect capital cost of the remedy. Operation and maintenance costs incurred over the life of the project, as well as present worth costs, are also evaluated. This comparison of costs among alternatives is presented in Table 11.

Alternative 4 is considered the most cost-effective alternative. Although the cost of Alternative 2 is less than Alternative 4, Alternative 2 is considered less effective and may not meet the RAOs. The significant increase in costs for Alternative 3 is not justified since Alternative 3 is considered less protective than Alternative 4. Alternative 5a and 5b are both effective but are significantly more costly than Alternative 4.

12.3 Modifying Criteria

The two modifying criteria of community and state acceptance are intended to assess the views of both groups regarding various cleanup approaches. The EPA has held numerous meetings with the MDNR and the Jasper County Citizen's Task Force to discuss the effectiveness of sub-aqueous disposal. The EPA held a public meeting and opened a comment period to assess the publics' opinion and preference for a remedy. Comments received from the public indicate that the community fully supports Alternative 4 as the preferred alternative. MDNR supports the modified Alternative 4 as the Selected Remedy as presented in this ROD.

13.0 Selected Alternative

This section presents the detailed description of the EPA's selected alternative, which is Alternative 4 in the FS, with the exception that the EPA has modified the alternative slightly by eliminating the chat recycling ICs, and revising the action levels based on comments received from the public. Alternative 4 is a remedial alternative based on excavating and disposing of source materials in on-site subsidence pits for addressing the principal threats, i.e., risks to aquatic biota caused by surface water containing COCs in concentrations exceeding ALCs, potential risks to terrestrial vermivores that may be caused by ingesting metals from soils exceeding threshold criteria, and exposure of people to metals-contaminated soil and mine wastes. This alternative relies on excavation and on-site disposal and prescribes a high degree of mine and mill waste consolidation to address the RAOs. In addition, the timeframe for this alternative is aggressive because the schedule is not dependent on the availability of biosolids or the time required to construct simple soil covers on numerous waste containment cells. Detailed costs associated with the implementation of Alternative 4 are presented Table 12. The total cost estimated for this Alternative is $58,543,332 for construction, with an estimated annual operation and maintenance cost of $22,500.

The detailed description of Alternative 4 is presented in the following subsections.

13.1 Selected Alternative Rationale

Alternative 4 relies on the disposal of source materials in on-site subsidence pits to achieve significant reductions in COC loadings to surface waters, as well as reducing risks to terrestrial vermivores, and to people who may move into residences constructed in contaminated areas. In contrast to the current situation in which mill wastes have been placed aboveground and are exposed to erosion and natural weathering forces, Alternative 4 takes advantage of the naturally-occurring geochemical conditions underground, especially in flooded mine workings, to arrest the natural weathering processes and create favorable conditions for the formation of relatively insoluble mineral assemblages. A short-term release of metals to groundwater after placing the mill wastes in the subsidence pits is expected. However, the impacts to surface waters should be localized and the affect on surface water metal loading relatively minor when compared to the significant role played by surficial waste deposits as a metals source during high-flow conditions.

A growing body of engineering experience and scientific investigation points to underground or underwater (subaqueous) disposal of mining and milling wastes as a cost-effective and environmentally safe disposal method. The results of batch leach tests of Galena, Kansas area mine wastes were used to model the subaqueous disposal of mill wastes. The report concluded that placing mill waste underground in subsidence pits can significantly reduce the transport of metals from the wastes to surface waters. Recent site-specific work performed by MDNR in the Logan Uplands area of the Oronogo/Duenweg DA supports the conclusion that subaqueous disposal of mineralized waste rock does not adversely affect groundwater quality. To further evaluate and document the effects of this alternative, a subsidence pit demonstration project was initiated in the Waco DA in July 2001. This demonstration project was designed to evaluate the possible changes in local groundwater chemistry and surface water quality near the demonstration disposal pit and confirm that disposal of mill wastes in subsidence pits in general would have no long-term adverse impacts on groundwater or surface water. The demonstration was completed in the spring of 2003. The study showed that filling a pit with approximately 60,000 cubic yards of tailings with high concentrations of zinc did not result in a long-term increase in zinc concentrations in the groundwater.

Filling open subsidence pits should also reduce the influx of oxygen into the shallow aquifer. Reducing the oxygen flux into the shallow aquifer will improve groundwater quality by reducing the oxidation of pyrite and other sulfide minerals remaining in the underground workings. The rationale for developing an alternative based on subsidence pit disposal is based on these findings and conclusions. An incidental benefit of this alternative would be the stabilizing effect that backfilling would have on mine collapse features in the Site. Filling selected subsidence pits would address potential human health risks associated with the physical hazards posed by open pits, as well as eliminate some nuisance trash pits in the area.

Due to the extremely complex and varied nature of the site and the innovative nature of the preferred alternative, a flexible approach with respect to applying technologies from other alternatives may be necessary during implementation. In other words, components of other alternatives in the FS, such as biosolid treatment and capping of certain source materials may be necessary as conditions warrant. Where wastes are remotely located from disposal pits, or where removal of wastes from deep, depressions would result in excessively deep excavation and water ponding, capping of the wastes with simple soil covers will be used to encapsulate the wastes in place.

13.2 Detailed Description of the Selected Remedy

The following section provides a detailed description of the EPA's preferred remedy for cleanup of the source material on the site.

13.2.1 Engineered Cleanup Actions

Specific actions implemented under Alternative 4 include the engineering components described in the FS with respect to remediation of the source materials. As noted above, the preferred alternative is slightly modified from the description of Alternative 4 in the FS with respect to the ICs discussed in Section 13.2.2 because chat recycling is eliminated as a component of this ROD, and the selected action levels for the Site. The specific actions of the selected alternative include the actions listed below. The order of priority for cleanup of the source materials will be to address the wastes located in close proximity residential areas, followed by cleanup of wastes that present the highest risk to aquatic life. Waste areas that do not present significant human health or aquatic risk, but present risk to the terrestrial environment will be cleaned up as the last priority.

Source Removal and Disposal in Subsidence Pits

In- and near-stream barren chat, vegetated chat, and tailings; barren chat, vegetated chat, and tailings located in the flood plains and tributaries; upland chat and tailings exceeding terrestrial and human health action levels would be excavated and placed in mine subsidence pits located in proximity to the source material. Backfilling the pits would be accomplished by simply end-dumping and/or pushing the mill wastes into the pits with excavation equipment.

To the extent possible, tailings and chat would be placed at least a meter below the seasonal low static water level in the pits. Reducing repeated wetting and drying of the wastes as a result of seasonal water level fluctuations is considered important for arresting weathering, oxidation, and acid generation processes, and preventing further leaching of metals from the wastes. Relatively inert materials, such as development rock or low-concentration chat would be used to fill the zones where water levels may fluctuate. Flooded pits that contain high quality habitat for fish and wildlife, and contain low concentrations of metals in the water will not be used for disposal because they do not present a risk to human health or the environment. There appears to be sufficient pit space available on the Site to warrant saving good quality habitat.

Upland Source Materials

Upland barren chat and tailings that do not exceed action levels established to protect terrestrial and human health would be left in place because they do not pose a risk to human health and the environment. Upland vegetated chat and transition zone soils that exceed human health and terrestrial cleanup criteria would be deep tilled to reduce metal concentrations and revegetated. Biosolids would be added to provide some treatment of the metals in these sources, and to improve soil structure for plant growth.

Sediment Removal

Sediments in the intermittent tributaries flowing from the sources areas to the Class P streams will be removed subsequent to the cleanup of the sources draining to the tributaries. The sediments will be removed to a depth where background metals concentrations or bedrock is encountered, which ever is shallower. Sediment basins and traps will be constructed at the mouths of the tributaries to be remediated to mitigate sediment transport to the Class P streams during the cleanup actions. Remediated tributaries will be restored by lining the channels with clean gravel and stabilizing the banks with natural vegetation.

Sediment removal actions in Class P streams would be limited to delta deposit built up at tributary mouths. Generally, all the sediments in the deltas exceed screening criteria for aquatic organisms. Therefore, all the sediment delta deposits at the mouths of the tributaries exposed above the waterline at low-flow conditions will be removed. Extensive removal is not anticipated under this alternative because the estimated volume of delta deposits is small based the site sediment surveys conducted jointly by the EPA, the MDNR, and NewFields in November 1999 and April 2003. The excavated sediments would be disposed in subsidence pits with the other source materials. Removal of the delta deposit sediments will occur at each tributary at the completion of the removal of the sediment in the individual tributary. It is anticipated that all sediments from the tributaries draining source areas to the Class P stream will require complete removal up to the source areas. Once the tributaries have been cleaned of sediments, the channels will be restored to as near natural condition as possible. This would include replacement of clean gravel in the channels and bank stabilization.

This ROD is establishing numeric action levels for cleanup of the tributary sediments and delta deposits of 2 ppm cadmium, 70 ppm lead, and 250 ppm zinc. These concentrations were derived from the average concentration of background designated soil values. The EPA also assessed screening values for sediments in the consensus-based Threshold Effects Criteria (TEC) for freshwater, developed by MacDonald et al. (2000). The MacDonald values are recommended as numeric sediment quality criteria because TEC values are intended to predict the absence of toxicity in sediments. Although TEC values are often used for the purpose of ecological screening to determine contaminants of potential ecological concern, they also provide a reliable basis for classifying sediments as toxic or not toxic to sediment dwelling organisms. Comparing the threshold effects concentration to the probable effects concentration give a range of 1 to 5 ppm (average of 3) for cadmium, 32 to 128 ppm (average of 80) for lead, and 121 to 459 ppm (average of 290) for zinc. The average background soil concentrations for the Site fall with in this range of screening values, and are slightly lower than the average recommended MacDonald values.

During implementation of the remedy, the EPA will initiate the surface water quality monitoring plan to assess the effectiveness of the source removal action on reducing surface water quality to meet Federal ALC. If at the second Five Year Review after completion of the remedy (10 years or less), conducted as required for the Site, monitoring data indicated the Federal ALC has not been achieved, the EPA will assess the feasibility of conducting additional actions. These may include the removal of sediments from the Class P streams, which is currently not part of the remedial actions selected in the ROD. Additional action may be taken under an amendment to this ROD, or as part of a new operable unit. If the assessment of data indicates the need for additional source material (i.e. mine waste or soil) removal is required, those additional actions would be conducted under an amendment to this ROD. Should the data indicate that sediment removal from the Class P streams is necessary to achieve the federal ALC, those actions would be conducted under a separate OU and ROD. Should the EPA determine that an additional OU and ROD for sediments is warranted, sediment removal activities would be conducted simultaneously with sediment actions in the Spring River drainage in Kansas and Oklahoma.

Recontour, Revegetate, Soil Amendments, Stabilization

A variety of drainage and erosion control measures will be implemented during and after excavation of the source materials to manage storm water runoff and reduce metal and sediment loadings to Class P streams and their tributaries. Excavated areas will be recontoured and revegetated following complete removal of the mill wastes in order to control runoff and prevent surface erosion. Deep tilling would be performed to improve soil structure and moisture retention characteristics by blending the organic matter content of different soil horizons, as well as reducing contaminant concentrations, to reduce risks to human health and terrestrial biota, and improve soil function. The soils would be amended with biosolids to supplement the soil organic matter content and facilitate revegetation, which may also provide some treatment to any residual metals not excavated during subaqueous disposal. Excavated areas will be contoured to promote proper drainage, preventing ponding of water in the excavated areas. Excavated areas will be revegetated using native, warm-season grass, or other grass types, dependent on the wishes of the property owner. Stream channels and banks from which source materials have been removed would be stabilized through the use of appropriate restoration techniques, such as recontouring, regrading, revegetating, or installing erosion barriers, stone armor, or riprap. Natural vegetation, such as willows or cedar revetments, would be used to stabilize remediated channels instead of stone rip-rap, where practical.

Selection and Capping of Disposal Pits

Pits will be evaluated during the remedial action for their suitability as disposal sites. Pits directly connected to the surface water system, containing highly oxygenated water, or exhibiting high groundwater flux will preferably be excluded from consideration as disposal sites. Pits within ½ mile of Class P streams with exceedances of ALCs will also be excluded depending on the degree of karst development or mining-related conduit flow. Pits within one-mile upgradient of shallow drinking water wells that are still in use will be excluded from consideration for disposal. Pits exhibiting low dissolved oxygen concentrations and low oxidation/reduction potential will be considered good candidates for disposal sites. The filled pits will be capped with geo-composite soil covers to nearly eliminate infiltration of oxygenated rainwater, thereby reducing the weathering of the disposed wastes. Actions, such as mounding the cover systems and diverting surface flows away from the capped pits will also be taken to reduce the infiltration of oxygenated water into the disposal pits. In- and near-stream transition zone soils exceeding the action level for human health and terrestrial risk or soils from beneath excavated chat piles will be excavated and used in the construction of the soil cover systems. To prevent damage to the cover systems due to consolidation and differential settling of the mill wastes placed in the pits, adequate time (six to twelve months), will be allowed for the mill wastes to consolidate in the subsidence pits prior to attempting to install the cover systems. Any subsidence that occurs during the consolidation period will be filled in with additional mill wastes or soils to provide positive slopes and adequate drainage for the cover system. Erosion control measures will be installed at each filled pit to control runoff prior to the cap installation during the settling period. Only low-concentration mill waste or development rock will be used to fill settled areas in the pits after subsidence of initial materials disposed prior to the cap installation.

In addition, groundwater monitoring wells will be installed around the first few pits where disposal occurs to confirm the results of the Waco pilot study concerning the short-term and long-term release of metals. The monitoring data collected from the wells will be used to further define the appropriateness of various types of pits for disposal, and refine disposal criteria. Monitoring will be conducted weekly for the first two months, monthly for months three through six, quarterly for the remainder of year one, then semi-annually until the first Five Year Review.

Shaft Plugging

Surface water and sediment RAOs will be addressed through the source material and sediment removal options described above. Where practical, the groundwater RAO will be addressed by installing shaft plugs and diversion ditches to reduce the amount of surface water entering the mine workings. The purpose of these actions will be to reduce point and non-point groundwater discharge from mining-related sources to streams.

Thorns DA Open Mine Pits

The acidic overburden from the Wild Goose open pit mine in the Thorns DA will be excavated and disposed underwater in the TH-12 pit. Other mill wastes from the Thorns DA will also be disposed in this open pit, as well. Due to the size of the pit, however, there is not enough mill waste or overburden in the Thorns DA to completely fill the Wild Goose open pit TH-12. Therefore, the EPA Will assess hauling wastes from other DAs to facilitate complete filling of the pit. Water displaced by the filling of the pit will be neutralized and treated with lime in a temporary mobile treatment plant to remove the cadmium, iron, lead, and zinc prior to discharging it to the nearby Center Creek tributary (CC Trib 6). An open limestone drain will be installed at the outlet of the pond to neutralize any subsequent discharges that may occur following the remedial actions, if the pit is only partially filled. Lands exposed by the excavation of the reactive overburden will be deep tilled, limed, and amended with biosolids or other organic matter and revegetated the same as other excavated mill waste deposits.

Filling of the Wild Goose pit, with its current low pH waters, presents a special concern for subaqueous disposal of wastes. The acidic nature of these waters could mobilize metals and result in groundwater conditions not suitable for subaqueous disposal. The acidic overburden may need to be treated to reduce acidity prior to placing it into the pit with mill wastes. Only partially filling the pit will result in open water at the surface that could serve as a continual input of oxygenated water, thereby negating anaerobic conditions to stabilize metals. If open surface water is left in the pit, it could be an attractive nuisance and could harm wildlife, particularly waterfowl. This scenario of disposal needs to be fully studied and modeled to show if it is effective prior to implementing action at the pit. Pilot studies will be required to assess the effectiveness of treatment technologies prior to full implementation of the filling action. It is likely, that is the treatability and pilot study results will show that the pit can be filled without significant metals release, but that the pit should be completely filled and capped.

13.2.2 Institutional Controls

The ROD for the smelter-affected and mining-affected residential yard soils in Jasper County (OU-2/3) prescribes ICs to reduce future exposure of children to unacceptable concentrations of lead in soils in new residential construction in all undeveloped contaminated areas. Those ICs were envisioned to consist of a Site-wide zoning ordinance that will control new development in mine-affected areas, building codes or health ordinances that will require remediation of soils exceeding the risk-based clean-up standards in new residential construction, and deed restrictions on excavated yard soil repository sites to protect them from human disturbance. The ICs are being considered and developed through a cooperative effort between the EPA, Jasper County, and the city of Joplin, Missouri. However, to date, the implementing ordinances have not been enacted. Thus, the preferred alternative for OU-1 incorporates the ICs that were required under OU-2/3 and allows the county and cities greater flexibility in adopting such ICs in light of the more permanent and reliable proposed action in this ROD, i.e., disposal and containment of the source materials.

The selected alternative for OU-1 includes a site-wide building ordinance that would be enacted by Jasper County, similar to the health ordinance prescribed in the OU-2/3 ROD. The EPA has discussed this IC with jasper County. The county would propose a building ordinance for all undeveloped areas within the site that requires the builders of residential homes to obtain a permit for construction. Conditions of the permit would require soil testing to determine the lead concentration of the soil in the yard area of the home. The EPA will work with the county to develop appropriate sampling procedures to ensure the reliability of the results. An occupancy permit will only be granted by the county if soil lead concentrations are below 400 ppm and cadmium will be below 75 ppm. Builders will be required to properly cleanup soils exceeding these levels prior to receiving the occupancy permit. The EPA will provide funding to Jasper County to establish and implement the building permit ordinance. After the completion of the OU-1 cleanup, the surficial source materials (mine and milling wastes) will be contained in the subsidence pits. Thus, the building ordinance controlling residential development will no longer be required. The selected alternative does not require, but tolerates a planned termination date for the county building ordinance if the county prefers that the ordinance only be effective for a limited term. For example, the ordinance could terminate upon completion of the remedial action.

The selected alternative prescribes disposal of mine and mill wastes in mine subsidence pits followed by capping of the wastes. Some waste areas may be contained and capped in place with soils or biosolids. All capped areas and biosolids treated areas will require ICs to prevent disturbance of the cap thereby protecting the wastes. These ICs will likely consist of restrictions or easements placed on the property deeds for the areas where the disposal or containment occurs. The restriction will prevent the development on, and disturbance of, the caps placed over the wastes. Restrictive covenants may be entered into with owners of the disposal property for protection of the disposal and capped areas.

This ROD excludes chat recycling as a component of the Selected Alternative. The effective and more permanent engineering control components of the selected alternative eliminate the need for legal agreements to control recycling. Reducing risks to human health and the environment from chat recycling through legal agreements with individual owners/operators is administratively infeasible because of the large size of this Site, about 5,000 acres of mine waste piles and 500 owner/operators, and the far-reaching impact of such agreements, i.e., end uses, accumulation, speculation, storage, surface water protection, and final closure. Moreover, the legal agreements would duplicate ARARs under the Clean Water Act (CWA) that regulate discharge of pollutants and contaminants into surface waters. If enforcement actions are needed to control surface water pollution from mine waste piles prior to completion of the engineering components selected in this ROD, the CWA may be used on a case-by-case basis to regulate surface water pollution caused by chat recycling.

13.2.3 Health Education

The ROD for OU-2/3 required the implementation of a health education program in Jasper County to supplement the residential soil cleanup. The EPA has been funding the Jasper County Health Department to implement that health education program since 1996. Since human health exposure risks due to direct contact with source materials containing the metals contamination is possible until completion of the mine and mill waste cleanup described in this ROD, the EPA will continue to fund the health education program until the cleanup of OU-1 is complete. When the cleanup action is completed for OU-1, and at the completion of additional actions anticipated under OU-2/3, which essentially means that Superfund Site sources for human exposure have been addressed, the health education program will no longer be funded by the EPA.

13.2.4 Stream Monitoring

One of the primary RAOs for the selected alternative for surface water is to reduce the exposure of aquatic organisms in the Class P streams to COCs where federal ALC are exceeded. The EPA believes the actions taken under the preferred alternative will reduce concentrations of metals in the Class P stream to less than federal ALC based on hardness. These actions include removal of all source material with erosion potential to the streams, tributary sediments, and all sediment delta deposits above the low water line at the mouths of the tributaries draining source areas into the Class P streams. During the remedial action for OU-1, the EPA will establish a water quality monitoring program for the Class P streams to assess the effectiveness of the remedial action on reducing metals loads. The EPA will collect monitoring data which will be used during the five-year review process, and will be collected and assessed at each review until the metals concentrations are in compliance with the ALC. Should the goal of achieving the ALC fail to be achieved within two Five-Year Review periods (10 years) after completion of the remedial action, or if water quality standards established by states or tribes for downstream receiving surface waters show no improvement within this 10-year period, the EPA will assess the feasibility and practicality of conducting additional actions at the Site to further reduce the metals concentrations in the Class P streams. Should additional actions be required, the work may be conducted under an amendment to this ROD for OU-1, or if warranted by extensive basis-wide action, a new operable unit for sediment removal may be established to address the Class P streams at the Site.

13.2.5 Operation and Maintenance

An O&M program will be established to maintain the caps on the disposal areas and to maintain other engineering components of the preferred alternative, e.g., areas of biosolids or soil application where wastes were left in place, groundwater monitoring, and revegetated areas. The state will be responsible for the O&M beginning one year after the completion of the remedial action. If the local government enforces the ICs, the state remains responsible for O&M of such local government controls.

The state's O&M responsibilities will include a monitoring program to assess the effectiveness of the ICs. The monitoring program will provide annual reports to the EPA detailing the development in areas of concern to protect engineering components. Monitoring requirements will be assessed during the five-year review process and may be modified or reduced as appropriate based on data collected as part of the reviews.

14.0 Statutory Determination

Under its legal authority, the EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this Site must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws, unless a statutory waiver is justified. The selected remedy also must be cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

14.1 Protection of Human Health and the Environment

The selected remedy will protect human health and the environment by achieving the Remedial Action Objective through a combination of engineering measures and institutional controls. Existing terrestrial and aquatic risks from exposure to metals contaminated source materials will be mitigated by removal and disposal of the source materials in mine subsidence pits. Future risks to human health will be reduced by source removal and implementation of institutional controls that will ensure proper construction of residential dwellings in contaminated areas.

There are no short-term threats associated with implementation of the remedy that cannot be readily controlled. In addition, no long-term adverse cross-media impacts are expected from the remedy.

14.2 Attainment ARARs

Compliance with ARARs is required of the selected remedy unless a waiver of an ARAR is justified. The selected remedy is expected to comply with all ARARs, presented in the attached tables. ARARs for the selected remedy are identified and categorized as either “Applicable” or “Relevant and Appropriate” in Table 4 through 6. These tables also describe the requirements for each ARAR.

14.2.1 Chemical-Specific ARARs

The chemical-specific ARARs are presented in Table 4. The selected remedy is expected to comply with all identified requirements through excavation and disposal of the source materials and selected sediments.

14.2.2 Action-Specific ARARs

The action-specific ARARs are based on activities and technologies to be implemented at the site. The excavation and disposal activities undertaken by the selected remedy will attain the action-specific ARARs identified in Table 5.

14.2.3 Location-Specific ARARs

Compliance with location- and action-specific ARARs will be addressed during the remedial design of selected remedy which requires excavation and disposal of metals contaminated source materials. However, no remedial design problems resulting in noncompliance are anticipated.

The location-specific ARARs that will be attained by this remedial action are based on the location of the Site and the effect of the hazardous substances on the environment. The response actions undertaken by the selected remedy will attain the location-specific ARARs for historic preservation, archeological areas, and endangered species. These location specific ARARs are identified in Table 6.

14.3 Cost-Effectiveness

The selected remedy is cost-effective because it will provide overall effectiveness proportional to its costs. The selected remedy will achieve the remedial action objective, and thus effectively reduce unacceptable risks to human health and the environment, at an estimated cost of $58,543,000 million. The selected remedy is the least expensive remedy that is fully protective of human health and the environment, and is selected because it is the most protective, reliable, and permanent of the alternatives considered, and is the alternative preferred by the public.

14.4 Utilization of Permanent Solutions and Alternative Treatment Technology to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for this remedial action. Disposal of the wastes in subsidence pits, as opposed to surface disposal and capping, provides the most permanent disposal of the identified remedial actions. The other actions which are part of the selected remedy, institutional controls and monitoring, are not as permanent as the engineering actions, but will still provide a high degree of long-term effectiveness.

The selected remedy provides the best balance among the alternatives evaluated with respect to the evaluation criteria. The EPA relied strongly on the issue of permanence and reliability, as well as community acceptance, in selection of the remedy. The selected remedy best meets the statutory requirement to utilize permanent solutions to the maximum extent practicable.

14.5 Preference for Treatment as a Principal Element

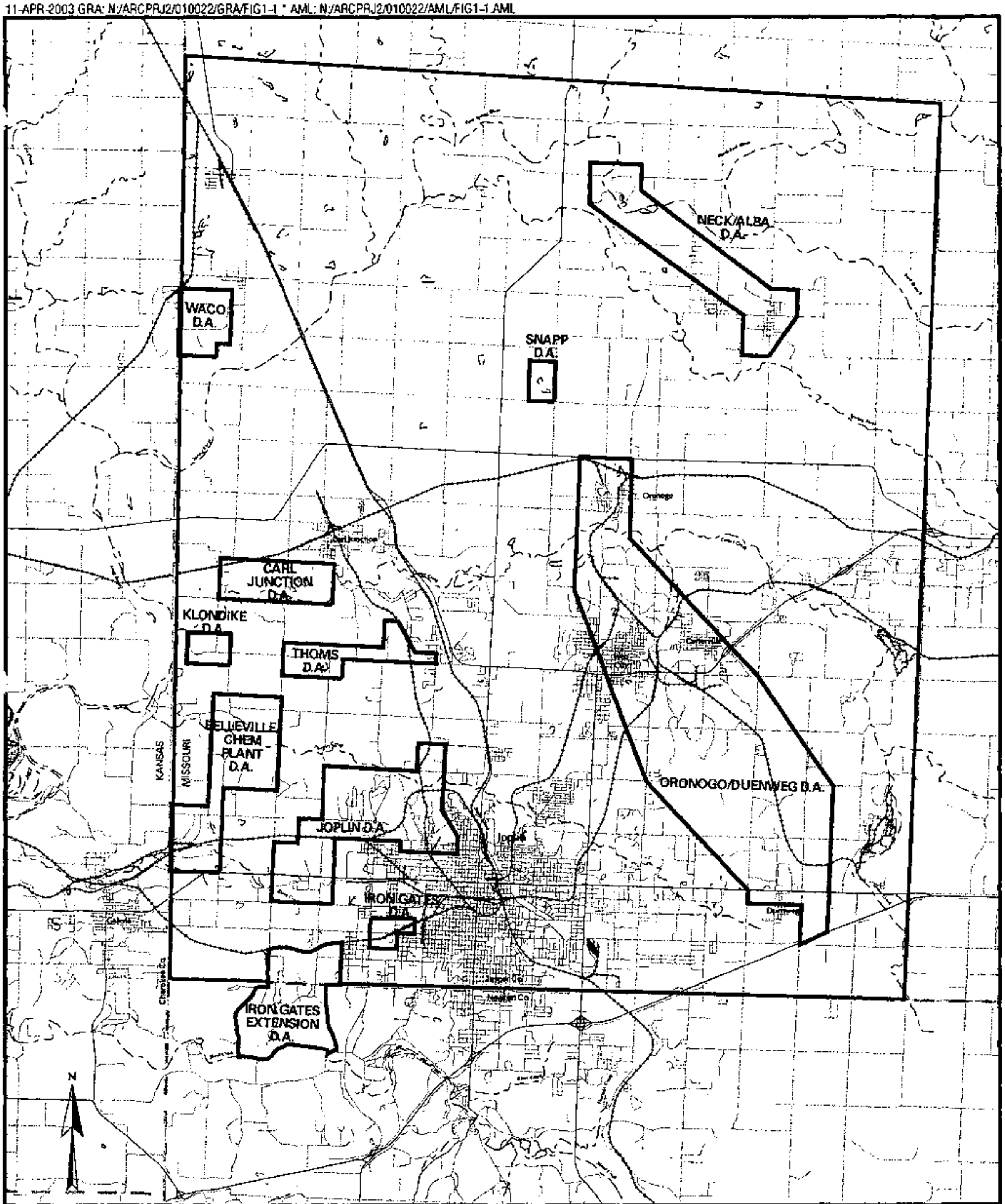
The selected remedy effectively reduces risks through a combination of engineering and institutional controls, and includes treatment technology to the maximum extent possible. Subaqueous disposal of source materials is expected to create anaerobic conditions in the subsurface which will reduce the solubility of metals in the wastes, limiting their migration.

15.0 Documentation of Significant Changes

This Record of Decision is essentially the same as presented in the Proposed Plan released for OU 1 in July, 2004, with the exception of the action levels specified for cleanup, and the cost of institutional controls. The Proposed Plan presented action levels of 800 ppm lead, 40 ppm cadmium, and 6,400 ppm zinc to protect the terrestrial environment. Local health officials requested the EPA to lower the action level for lead to 400 ppm. This request was made due to the fact that the county is anticipating establishing a building ordinance for residential construction in contaminated areas that would require soil in yards to be less than 400 ppm lead. The health officials noted that unless the Site sources were remediated to less than 400 ppm lead, the building ordinance, health education, and funding support for both would be required in perpetuity. The cost estimate prepared for Alternative 4, the selected remedy, in the FS assumed all upland chat and tailings will exceeded the terrestrial action level for lead of 800 ppm. Lowering the action level for lead from 800 ppm to 400 ppm to provide additional protection for future human health did not increase cost to remove and dispose chat and tailings. The amount of transition zone soil requiring removal by lowering the action levels resulted in an additional 300 acres and increased costs by approximately $1,091,000. Additionally, the EPA inadvertently left out the appropriate cost of institutional controls from the Proposed Plan. Costs for the ICs increased the Site costs by $1,600,000. However, the EPA believes the Proposed Plan over estimated the amount of biosolids required to complete the remedial action. The FS assumed 50 tons per acre of biosolids would be placed in all cleanup areas after excavation. The EPA believes 10 tons per acre is a more reasonable amount to provide nutrients for plant growth in the excavated areas. Vegetated chat areas will be treated with 75 tons per acre. This reduction in the amount of required biosolids reduced cost by $4 million. Overall, the costs presented in this ROD are $3.1 million less than presented in the Proposed Plan.

The EPA developed terrestrial cleanup criteria for the Site during the remedial investigation and feasibility study process. These numbers were developed and selected in the "Addendum to the Baseline Ecological Risk Assessment" and the "Technical Memorandum: Risk Management Considerations for Terrestrial Vermivores". The cleanup criteria were derived by calculating soil concentrations, using a regression analysis between soil concentrations and measured earthworm and soil invertebrate concentrations, which would result in a hazard index (HI) of 1 for shrews. Subsequently, the EPA has reassessed these numbers, using different methods, to confirm their appropriateness for protecting the environment. The EPA has determined that the soil cleanup criteria, as developed using the regression analysis, may result in an HI between one and 10. This ROD is selecting the cleanup criteria developed in the Technical Memorandum and these criteria along with the fact that all erodable waste will be addressed, will provide for a protective remedy. However, the EPA acknowledges the uncertainties in accurately determining an HI using either of these different methods, including the regression analysis calculations. The EPA understands that the Natural Resource Trustees for the Site are conducting additional studies, including bird studies, which may refine the risk to the environment from contaminated soil. The EPA will review and assess these studies, and may collect additional data, at a minimum during the Five-Year Review process, to determine the protectiveness of the cleanup criteria established in this ROD. Additional cleanup action to lower metals concentrations in mine waste areas may be conducted, if warranted, based on the results of these Five-Year Reviews analyses.

11-APR-2003 GRA: N:/ARCPRJ2/010022/GRA/FIG1-1 * AML: N:/ARCPRJ2/010022/AML/FIG1-1.AML



EXPLANATION

- Stream or River
- Site Boundary
- Designated Area
- Roads

MFG, Inc.
consulting scientists and engineers

SCALE IN FEET

13000 0 13000

FEASIBILITY STUDY

Mine and Mill Waste Operable Unit

FIGURE 1 –1

JASPER COUNTY SITE MAP

PROJECT: 010022.4
DATE: APR 11, 2003
REV: 0
BY: MCP
CHECKED:

Table 1 Summary of Estimated Quantities of Source Materials and Affected Media

Designated Area	Units	Belleville	Carl Junction	Iron Gates	Iron Gates Extension	Joplin	Klondike	Neck/Alba	Oronogo-Duenweg	Snap	Thoms	Waco	Total
Source Material Categories													
In/Near Stream	Cu.Yds.	95,699	4,645				1,703	21,209	287,063				410,319 Cu.Yds.
Barren Chat	Acres	14.8	2.9				0.5	8.2	186.9				213.3 Acres
In/Near Stream	Cu.Yds.		8,574					30,302	114,035		467		153,378 Cu.Yds.
Vegetated Chat	Acres		5.3					36.6	141.4		0.6		183.9 Acres
In/Near Stream	Cu.Yds.							31,222	28,322				59,544 Cu.Yds.
Tailings	Acres							20.5	21.8				42 Acres
Barren Chat	Cu.Yds.	158,885			506,526	133,411	15,552		919,915		2,491	3,662	1,740,442 Cu.Yds.
Sediment Sources	Acres	28.8			78.5	100.8	2.4		438.9		3.1	2.3	655 Acres
Vegetated Chat	Cu.Yds.					33,634		6,068	34,193			26,103	99,998 Cu.Yds.
Sediment Sources	Acres					51.0		5.2	42.5			21.3	120 Acres
Tailings Sediment	Cu.Yds.					5,554.00			60,821.00	19,872	3,651		89,898 Cu.Yds.
Sources	Acres					5.2			48.4	8.2	2.3		64 Acres
Upland Barren Chat	Cu.Yds.	189,831	75,123		68,583	384,719	1,775	181,949	1,247,783	8,103	4,875	5,585	2,168,326 Cu.Yds.
	Acres	30.0	24.0		10.6	153.1	0.3	59.9	894.8	1.8	1.9	4.6	1,181 Acres
Upland Vegetated	Cu.Yds.		20,212			142,366		46,148	268,053	6456	18,144	124,305	625,684 Cu.Yds.
Chat	Acres		7.7			163.9		51.5	297.1	8	16.6	72.9	617.7 Acres
Upland Tailings	Cu.Yds.		28,217			24,031		12,244	42,593	44,008	22,315	1,465	174,873 Cu.Yds.
	Acres		9.2			13.5		13.4	91.8	23.1	5.5	1.0	157.5 Acres
Acidic	Cu.Yds.										335,661		335,661 Cu.Yds.
Overburden	Acres										39.0		39.0 Acres
Sediment Categories													
Stream Sediments	Cu.Yds.	3,703			2,135	702	448		1,912				8,900 Cu.Yds.
	Lin. Ft.	2,500			4,239	2,310	2,420		8,990				20,459 Lin. Ft.
Soil Categories													
In/Near Stream	Cu.Yds.	128,744	6,615	-	159,075	96,961	16,133	8,228	350,093	-	13,713	13,552	793,115 Cu.Yds.
Transition Zone Soil	Acres	79.8	4.1		98.6	60.1	10.0	5.1	217.0		8.5	8.4	491.6 Acres
Upland Transition	Cu.Yds.	97,123	104,705	8,067	21,619	275,719	1,613	74,052	526,592	-	26,620	20,328	1,156,437 Cu.Yds.
Zone Soils	Acres	60.20	64.90	5.00	13.40	170.90	1.00	45.90	326.40		16.50	12.60	716.8 Acres

Total	Cu.Yds.	Acres
Total Barren Chat	4,319,087	2,049
Total Vegetated Chat	879,060	922
Total Tailings	324,315	264
Total Sediments	8,900	-
Total Mill Wastes	5,531,362	3,235
Total Mill Wastes	5,531,362	3,235
Total Transition Zone Soils	1,949,552	1,208
Total Overburden	335,661	39.0
Total	7,816,575	4,482

Table 2 Comparative Analysis of Remedial Alternatives with Respect to Overall Protection of Human Health and the Environment
Jasper County, Missouri

Criterion	**Alternative 1** **No Further Action**	**Alternative 2** **Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling**	**Alternative 3** **Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegetation, and Recycling**	**Alternative 4** **Source Removal and Subsidence Pit Disposal**	**Alternative 5a** **Source Removal and On-Site Aboveground Disposal**	**Alternative 5b** **Source Removal, On-Site Aboveground Disposal, and Water Treatment**
How the Alternative Enhances Human Health Protection	Alternative 1 does not enhance human health protection measures already being implemented under OU-2, OU-3 and OU-4. Alternative 1 relies more on institutional controls to manage residual human health risks than any other alternative.	Alternative 2 enhances the human health protections being implemented under OU-2, 3, and 4, by removing more than 75% of the mill waste through recycling. However, direct revegetation of mill wastes is the least protective containment option of any action alternative. Alternative 2 requires an estimated 30 years to achieve the predicted enhancements of human health protections.	Alternative 3 enhances the human health protections already being implemented by capping mill wasted with soil covers. These covers would be protective of human health. However, this alternative results in the largest land area occupied by mill wastes and subject to institutional controls of any of the action alternatives. Alternative 3 requires an estimated 12 years to achieve the predicted enhancements of human health protections.	The disposal and capping method prescribed under Alternative 4 would be fully protective of human health. Only 710 acres would be subject to institutional controls needed for long-term protection of remedial facilities. Alternative 4 requires an estimated 7 years to achieve the predicted enhancements of human health protections.	The disposal and capping method prescribed under Alternative 5a would be fully protective of human health. However, more mill waste remains on the land surface than any other alternative, except 5b. Approximately 1080 acres would be subject to institutional controls needed for long-term protection of remedial facilities. Alternative 5a requires an estimated 7 years to achieve the predicted enhancements of human health protections.	The disposal and capping method prescribed under Alternative 5b would be fully protective of human health. However, more mill waste remains on the land surface than any other alternative. Approximately 280 acres would be subject to Institutional controls needed for long-term protection of remedial facilities. The level of enhancements of human health protections is achieved in the shortest timeframe, 5 years.
How the Alternative Provides Environmental Protection	Source materials RAOs are not met because large areas remain affected by mill wastes exceeding the RBCs. Risks to terrestrial vermivores may actually	Source materials exceeding RBCs remain on Site under Alternative 2. The source material RAO may not be fully met if biosolids applications prove ineffective in	The source material RAO is expected to be met under Alternative 3. Alternative 3 would probably not be capable of achieving the 90-95%	Source material RAOs are met under Alternative 4, the same as Alternatives 3, 5a, and 5b. Surface water RAOs and	The source material and surface water RAOs are met under all conditions, the same as under Alternatives 3, 4, and 5b. Residual risks to terrestrial vermivores and	The source material, surface water, and groundwater RAOs are met under all conditions, the same as under Alternatives 3, 4 and 5a.

Table 2 Comparative Analysis of Remedial Alternatives with Respect to Overall Protection of Human Health and the Environment Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegetation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal, On-Site Aboveground Disposal, and Water Treatment
	increase as more excavated barren chat areas become vegetated. Alternative 1 would not be capable of achieving the metal loading reductions needed to meet the surface water RAOs. No measures are taken to address the groundwater RAO. However, under all alternatives, the groundwater RAO may be met under current conditions despite the absence of remedial measures.	reducing metals bioavailability. Residual risks to vermivores are higher than other action alternatives. Alternative 2 would probably not be capable of achieving the 90-95% metal loading reductions needed to meet the surface water RAOs in all Class P streams and tributaries under all flow conditions. Direct revegetation of mill wastes using biosolids is expected to be the least adequate, permanent or reliable of any of the prescribed containment options. However, chat recycling is considered highly permanent and reliable and meets the objectives of treatment	metal loading reductions needed to meet the surface water RAOs in all Class P streams under all flow conditions. Simple soil covers are considered more permanent than direct revegetation, but less adequate or reliable than subsidence pit disposal or the engineered repositories prescribed under Alternatives 4, 5a, or 5b. The groundwater RAO is achieved, the same as all other alternatives. The same groundwater actions are prescribed as Alternatives 2, 4, and 5a. Alternative 3 requires 12 years to attain the predicted level of RAOs achievement.	ARARs are expected to be consistently achieved. Residual risks to aquatic life are lower than Alternatives 1, 2, or 3. Subsidence pit disposal is expected to be the most permanent and reliable disposal option of any prescribed. The groundwater RAO is achieved, the same as all other alternatives. RAOs are expected to be met under Alternative 4 in approximately 7 years.	aquatic life are lower than Alternatives 1, 2, or 3 but the same as Alternatives 4 and 5b. The groundwater RAO is achieved, the same as all other action alternatives. The engineered repositories prescribed under Alternative 5a are adequate and reliable, but are considered somewhat less permanent than subsidence pit disposal. RAOs are expected to be met under Alternative 5a in approximately 7 years.	The engineered repositories prescribed under Alternative 5b are adequate and reliable, but are considered somewhat less permanent than subsidence pit disposal. RAOs are expected to be met under Alternative 5b in approximately 5 years.

Table 2 Comparative Analysis of Remedial Alternatives with Respect to Overall Protection of Human Health and the Environment
Jasper County, Missouri

Criterion	**Alternative 1** **No Further Action**	**Alternative 2** **Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling**	**Alternative 3** **Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegetation, and Recycling**	**Alternative 4** **Source Removal and Subsidence Pit Disposal**	**Alternative 5a** **Source Removal and On-Site Aboveground Disposal**	**Alternative 5b** **Source Removal, On-Site Aboveground Disposal, and Water Treatment**
How the Alternative Provides Environmental Protection (continued)		Although the groundwater RAO may be met under current conditions, shaft plugs and diversion ditches are implemented to further reduce groundwater loadings to surface water. Alternative 2 requires 30 years to attain the predicted level of RAOs achievement.				

Table 3 Comparative Analysis of Remedial Alternatives with Respect to Compliance with ARARs
Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegetation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal, On-Site Aboveground Disposal, and Water Treatment
Compliance with Chemical-Specific ARARs	Under Alternative 1, exceedances of chemical-specific ARARs are expected to occur in Class P stream and regularly in some tributaries and miner's ditches during high flow conditions.	Alternative 2 would probably not be capable of achieving the 90-95% metal loading reductions needed to meet Federal chronic ALCs in all Class P streams under all flow conditions and would likely not meet ALCs in the tributaries or miner's ditches.	Same as Alternative 2.	Federal chronic ALCs are met in their respective Class P streams under all flow conditions.	Same as Alternative 4.	Same as Alternatives 4 and 5a.
Compliance with Action-Specific ARARs	Uncontrolled chat recycling does not comply with applicable storm water regulations that are identified as action-specific ARARs for this alternative. No other action-specific ARARs are identified for Alternative 1.	Potential action-specific ARARs identified under Alternative 2 include: Storm water regulations for chat recycling, requirements of 40 CFR Part 503 for biosolids applications, Federal and State NPDES storm water requirements, and the dredge and fill requirements of Section 404 of the CWA for excavating mill wastes and sediments from stream channels, and the NAAQS under the CAA.	Same as Alternative 2.	Dredge and fill requirements of Section 404 of the CWA, requirements of 40 CFR Part 503 for biosolids applications, Federal and State NPDES storm water requirements, and the NAAQS under the CAA are the only potential action-specific ARARs identified for Alternative 4. The Federal and State UIC regulations do not apply if only pits wider than they are deep are used for disposal sites.	Dredge and fill requirements of Section 404 of the CWA, requirements of 40 CFR Part 503 for biosolids applications, Federal and State NPDES storm water requirements, and the NAAQS under the CAA are the only potential action-specific ARARs identified for Alternatives 5a. Alternative 5a would comply with the potential action-specific ARARs identified for this alternative.	Same as Alternative 5a with the exception of the need for the requirements of 40 CFR Part 503 for biosolids applications.

Table 3 Comparative Analysis of Remedial Alternatives with Respect to Compliance with ARARs
Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegetation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal, On-Site Aboveground Disposal, and Water Treatment
		Alternative 2 would comply with these potential action-specific ARARs.		Alternative 4 would comply with the potential action-specific ARARs identified for this alternative.		
Compliance with Location-Specific ARARs	Alternative 1 complies with location specific ARARs.	Alternative 2 complies with location specific ARARs.	Same as Alternative 2.	Actions proposed under Alternative 4 comply with location-specific ARARs provided pits containing aquatic habitat are not used as disposal sites to assure compliance with habitat and wetland protection requirements.	Alternative 5a complies with location specific ARARs.	Same as Alternative 5a.
Compliance with Other Criteria, Advisories, and Guidance (TBCs)	Chat recycling may not always comply with guidance on appropriate chat uses to prevent risks to human health contained in EPA Region VII's Mine Waste Fact Sheet.	In contrast to Alternative 1, the controlled chat recycling prescribed under Alternative 2 is more likely to comply with EPA's guidance on appropriate chat uses to prevent risks to human health.	Same as Alternative 2.	The RCRA CAMU rule and the state and federal UIC regulations are ARARs if the pits meet the definition of a well or hazardous wastes or contaminated liquids are disposed. Otherwise, the UIC is a TBC. Alternative 4 would comply with the pertinent substantive guidance provided by these TBCs.	The RCRA CAMU rule is an action-specific TBCs for this alternative. Alternative 5a would comply with the pertinent substantive guidance provided by this TBC.	Same as Alternative 5a.

Table 4 Federal and State Chemical-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	I ARARs	To Be Considered
AIR				
FEDERAL REQUIREMENTS				
Clean Air Act – National Primary and Secondary Ambient Air Quality Standards	42 USC Secs. 7401 – 7671 40 CFR Part 50	The Clean Air Act and implementing regulations define air quality criteria for protecting human health, including standards for particulate matter and lead.	X	
STATE REQUIREMENTS				
Missouri Air Conservation Law	RSMo 643 10 CSR 10	Set ambient air quality standards for a variety of constituents, including particulate matter and lead.	X	
GROUNDWATER				
FEDERAL REQUIREMENTS				
Federal Safe Drinking Water Act – National Primary and Secondary Standards	40 CFR Parts 141 and 143	Establishes primary maximum contaminant levels (MCLs) and MCL goals (MCLGs) that are health-based standards for public drinking water systems, as well as secondary MCLs and MCLGs that are standards for constituents that affect only the aesthetic qualities of drinking water. According to the NCP, MCLs and MCLGs are ARARs for groundwater at Superfund sites.	X	
Technical Impracticability Waiver for Groundwater ARARs – Jasper County Site	Region VII EPA Record of Decision for the Groundwater Operable Unit (OU-4) of the Jasper County, Missouri Superfund Site, July 29, 1998.	This document established the technical impracticability (TI) of restoring the shallow groundwater aquifer in mined areas of the Jasper County site. The TI waiver determined that aquifer restoration was impracticable based on the large size and heterogeneous nature of the aquifer, lack of effective pumping and treatment technology, and the inordinate costs associated with groundwater treatment.		X
STATE REQUIREMENTS				
Missouri Safe Drinking Water Act	RSMo 640.100 – 140 10 CSR 60	Contains MCLs and monitoring requirements for drinking water supplies.	X	

Table 4 Federal and State Chemical-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	I ARARs	To Be Considered
SOURCE MATERIALS AND SOILS				
FEDERAL REQUIREMENTS				
Risk Management Considerations for Terrestrial Vermivores	NewFields and Black & Veatch 2001	Establishes site specific criteria for preventing risks to terrestrial vermivores. Source materials and soil criteria for vermivores include cadmium: 41 mg/kg; lead: 804 mg/kg; and zinc: 6,424 mg/kg. These criteria are not legal or regulatory standards but should be considered during alternative evaluation.		X
Baseline Ecological Risk Assessment for the Jasper County Superfund Site, Jasper County, Missouri.	Black and Veatch 1998	The BERA provides a screening level evaluation of potential risks to ecological receptors in the Site. The BERA identified the potential exposure pathways addressed in the Risk Management Considerations document cited above.		X
Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities.	OSWER Directive No. 9355.4-12, July 14, 1994	Recommends a screening level of 400 ppm for lead in residential soils. Describes methodology for developing site-specific preliminary remediation goals. Describes a plan for soil lead cleanup at sites with multiple sources of lead. This directive provides guidance for evaluating the extent to which proposed remedial actions might enhance protection of human health.		X
Soil Screening Guidance	OSWER Directive 9355.4-23, July 1996 EPA/540/R-961108 and 128	Recommends the development of site-specific soil screening levels. Provides general screening levels below which areas are determined to be adequate and do not need further assessment. Further evaluation of risks is recommended for areas above the screening levels.		X
STATE REQUIREMENTS				
Cleanup Levels for Missouri (CALM) Guidance	Missouri Department of Natural Resources' Cleanup Levels for Missouri Guidance, September 2001	The Cleanup Levels for Missouri (CALM) guidance document outlines a process for determining cleanup goals at sites with known or suspected hazardous substance contamination. MDNR and the Missouri Department of Health and Senior Services established CALM as a risk-based approach that takes into account land use (industrial, commercial, and unrestricted/residential), with three key tables listing soil and groundwater cleanup standards. These are not ARARs but may be TBCs.		X

Table 4 Federal and State Chemical-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	I ARARs	To Be Considered
SURFACE WATER				
FEDERAL REQUIREMENTS				
Clean Water Act – Water Quality Standards, Chronic Aquatic Life Criteria	40 CFR Sec. 131	Although the Federal chronic ALCs are not applicable, they are relevant and appropriate requirements for the perennial (Class P) streams and their tributaries for this Site because they are more stringent than the Missouri Water Quality Standards (WQS). The Federal ALCs for the COCs are based on the site-specific hardness of the surface water body. Therefore, the ALCs vary from stream to stream according to the hardness. Table 3-1 in the FS summarizes the Federal chronic ALCs for specific Class P streams within the Site. Tributaries to Class P streams would have hardness values determined during remedial design work.	X	
STATE REQUIREMENTS				
Missouri Clean Water Law– Water Quality Standards	RSMo 644.006 – 564 10 CSR 20-7.031	The Federal chronic ALCs are more stringent than the WQS established by Missouri under this law. Missouri is currently revising its WQS for streams and tributaries located within the Site. In the event that Missouri's new WQS are approved by EPA and no longer less stringent than the Federal ALCs, the WQS may become ARARs for the Site if they are adopted prior to ROD issuance. In assessing the remedy at the five-year reviews, the EPA will consider new information, such as new State WQS or site-specific standards in determining the protectiveness of the remedy.	X	
Missouri Clean Water Law– TMDL Regulations	Pending	Under this program, the State designates beneficial uses for waters of the state and to takes steps to determine if the uses are attainable and what the total maximum daily loads (TMDLs) should be to protect the designated uses. The TMDLs would be applicable to point discharges from abandoned mined lands, as well as active chat quarrying operations. The state TMDLs are currently not ARARs. However, Missouri and EPA are currently gathering supporting information for future implementation of a state TMDL program, and the TMDLs promulgated under this program could become ARARs when this program is formally implemented.		X

Table 4 Federal and State Chemical-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	I ARARs	To Be Considered
SEDIMENT				
Probable Effect Concentrations	McDonald *et al.,* 2000	Probable effect concentrations (PECs) are screening level concentrations of metals in fresh water sediments above which adverse effects may be expected to occur. PECs identified by McDonald *et al.* (2000) include 4.98 mg/kg for Cd; 128 mg/kg for Pb; and 459 mg/kg for Zn. However, these PECs are TBCs, as there are no applicable or relevant and appropriate criteria for sediments.		X
Equilibrium-Partitioning Sediment Guidelines (ESGs)	EPA Draft November 10, 1999 "Draft Metal Mixtures ESG Document"	Equilibrium-Partitioning Sediment Guidelines (ESGs) are EPA's best estimate of the concentration of the mixture of cadmium, copper, lead, nickel, silver and/or zinc that is protective of the presence of benthic organisms.		X

Table 5 Federal and State Chemical-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARARs	To Be Considered
FEDERAL ARARs				
National Ambient Air Quality Standards (NAAQS)	42 USC Sec. 7401 *et seq.* 40 CFR Part 250	These regulations establish ambient air quality standards for emissions of lead and particulate matter. Remedial actions taken under any of the alternatives (except no action) are likely to result in release of airborne lead and dust. These regulations are applicable to “major sources” as defined under the Clean Air Act Although remediation sites in Jasper County are not expected to be major sources, these regulations would be relevant and appropriate for the remedial activities at the Site.	X	
Resource Conservation and Recovery Act (RCRA), Subtitle D, Solid Waste Regulations	42 USC Sec. 6941 40 CFR Part 257, Criteria for Classification of Solid Waste Disposal Facilities and Practices	This section of the RCRA regulations requires the closure of existing solid waste facilities, design of new landfills, and disposal of solid wastes to be in accordance with various standards and criteria. These standards are applicable to solid waste disposal facilities, including mining and mill waste facilities. Among other things, these regulations require that facilities be maintained to prevent wash out of solid wastes and that the public not be allowed uncontrolled access.	X	
RCRA, Subtitle C, Identification and Listing of Hazardous Wastes	RCRA Section 3001(b)(3)(A)(iii), Beville exclusion of mineral extraction and beneficiation wastes. 40 CFR Part 264.2, Definition of solid waste and 40 CFR Part 261.4 (b) (7)	Mill waste within the Site is specifically excluded from regulation as hazardous wastes under the Beville exclusion because they are wastes resulting from mineral extraction and beneficiation. Therefore, the RCRA Subtitle C regulations are not ARARs.	X	
RCRA, Subtitle C, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	RCRA Section 3001 *et seq.* 42 USC Sec. 6921, *et seq.* 40 CFR Part 264.522, Disposal Of Hazardous Wastes In Designated Corrective Action Management Units (CAMUs). 40 CFS Part 264.554(D)(1)(i) and (ii) Staging Piles	The section defines Corrective Action Management Units (CAMUs) to be used in implementing corrective actions at Superfund Sites. A CAMU is defined as a disposal site used for consolidation or placement of remediation wastes within the contaminated areas of the site. Under these regulations, placement of wastes in a CAMU does not constitute land disposal of hazardous waste and does not constitute creation of a unit subject to the RCRA land disposal restrictions and minimum technology requirements (40 CFR Part 268). This Section of RCRA is not an ARAR because of the Beville exclusion, but certain substantive requirements related to design, operation and closure of disposal sites should be considered.		X

Table 5 Federal and State Chemical-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARARs	To Be Considered
Toxic Substances Control Act – Strategy for Reducing Lead Exposures	EPA, February 21, 1991	Presents strategies for reducing the amount of lead in the environment, as well as reducing blood lead levels, especially in children.		X
Surface Mining Control and Reclamation Act (SMCRA)	30 USC Secs. 1201-1328 30 CFR Part 816	SMCRA regulations govern coal exploration and active coal mining. Hence, these regulations are not applicable to remedial actions taken under OU-1 of the Jasper County Site. Nevertheless, some of the surface mining standards found in 30 CFR Part 816 should be considered because they address Circumstances similar to those at the Jasper County Site. Part 816 provides requirements for sediment control, grading requirements; and revegetation.		X
DOT Hazardous Materials Transportation Regulations	49 CFR Parts 107,171-177	Regulates transportation of hazardous materials. Would be relevant and appropriate for the transport of excavated materials within the site.	X	
Clean Water Act- Dredge or Fill Requirements (Section 404)	33 USC Secs. 1251-1376 40 CFR Parts 230, 231	Regulates discharge of dredged or fill material into navigable waters.	X	
Clean Water Act- Effluent Discharge Standards	40 CFR Sec.125.100 40 CFR Sec. 122.41	Requires that best management practices be maintained by the operator of a facility that discharges pollutants directly into the environment and requires that point source discharges be monitored to assure compliance with effluent discharge limits.	X	
Clean Water Act - Discharge of Storm Water	40 CFR Sec. 122.21 40 CFR Sec. 122.26	Regulates point and non-point storm water discharges associated with industrial activity and construction activities; includes requirements for best management practices and for pollution prevention plans. Industrial activity includes active and inactive mining areas.	X	
Safe Drinking Water Act – Underground Injection Control Program	42 USC Secs. 300f – 300j 40 CFR Part 144 – 148	Regulates disposal of wastes in underground injection wells to ensure protection of drinking water sources.	X	
Federal Sewage Sludge Management Program – Land Application Regulations	40 CFR, Chapter I, Subchapter O, Part 503	This subpart contains the applicable requirements for persons who prepare sewage sludge for land application and who applies sludge to land. These regulations include performance standards for pathogen reduction and criteria for metals concentrations in the sludge and soils where the sludge is applied as a means of protecting human health. Rules for applying sludge near surface water bodies are also included to prevent pollution of streams, rivers, and lakes.	X	

Table 5 Federal and State Chemical-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARARs	To Be Considered
EPA Mine Waste	EPA Region 7 Fact Sheet, February 2003	Provides public guidance on mine waste usage in the states of Missouri and Kansas. Provides a list of uses for mine waste what is not likely to present a threat to human health or the environment.		X
EPA's EE/CA for Removal Actions for the Highway 249 Project	EPA, 2000a	Provides site-specific guidance for excavation and disposal of mill wastes, including guidance on identification of ARARs.		X
STATE REQUIREMENTS			X	
Missouri Fugitive Particulate Matter Regulations	10 CSR 10-6.170	The Missouri fugitive particulate matter regulations contain restrictions on the release of particulate matter to ambient air. These regulations are applicable to any dust emissions that occur as a result of remedial actions taken at the site.	X	
Missouri Clean Water Law– Effluent Regulations	RSMo 644.006 – 564 10 CSR 20-7.015	Regulates the discharge of constituents from any point source, including storm water, into waters of the state. Provides for maintenance and protection of public health and aquatic life uses of surface water and groundwater. State permits would not be required under CERCLA, but the substantive provisions would be applicable.	X	
Missouri Clean Water Law– Construction and Operating Permits	10 CSR 20-6.010	Requires permits for discharges from point sources of water contamination. Although permits are not required for remedial actions conducted under CERCLA, these regulations may be relevant and appropriate to corrective actions taken at the site.	X	
Missouri Clean Water Law– Storm Water Regulations	10 CSR 20-6.200	Requires permits for metal and non-metal mining facilities and land uses or disturbances that create point source discharges of storm water. These regulations define Best Management Practices for land disturbances, including practices or procedures that would reduce the amount of metals in soils and sediments available for transport to waters of the state. Permits would not be required for actions taken under CERCLA, but the substantive provisions of these regulations would be applicable.	X	
Missouri Clean Water Law– TMDL Regulations	MOU between EPA and MDNR regarding the state's implementation of Section 303(d) of the federal Clean Water Act and 10 CSR 20-7	Requires the state to designate beneficial uses for waters of the state and to takes steps to determine if the uses are attainable and what the total maximum daily loads (TMDLs) should be to protect the designated uses. The TMDLs would be applicable to point discharges from abandoned mined lands, as well as active chat quarrying operations.	X	

Table 5 Federal and State Chemical-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARARs	To Be Considered
Missouri Clean Water Law– Underground Injection Control Program	Class I: RSMo 577.155 Class III: 10 CSR 20.6.090	Class I wells used to inject hazardous wastes or dispose of industrial and municipal fluids beneath the lowest underground source of drinking water are banned in Missouri by RSMo 577.155. Class III wells are used to inject fluids to extract minerals and are regulated under 10 CSR 20-6.090 and permitted under the authority of RSMo 644. The UIC regulations would be ARARs if disposal sites meet the definition of a well.	X	
Missouri Well Drillers' Law	RSMo 256.600 – 640 10 CSR 23	Sets fees and standards to be followed in installing, maintaining, and abandoning water wells and monitoring wells. Covers well plugging and proper isolation of possible sources of contamination from existing wells.	X	
Missouri Solid Waste Disposal Law	RSMo 260.200 – 345 10 CSR 80	Regulates facilities used for the disposal nonhazardous industrial, commercial, agricultural, infections, and domestic wastes. Does not apply to the disposal of overburden, rock, tailings, matte, slag, or other waste material resulting from mining, milling, or smelting. However, the regulations are considered relevant and appropriate.	X	
Missouri Hazardous Waste Management Law	RSMo 260.350 – 434 10 CSR 25	Regulates the generation, identification, treatment and disposal of hazardous wastes. These regulations are not applicable, relevant or appropriate to mining and beneficiation wastes. However, certain requirements related to design, operation and closure of disposal sites should be considered.		X
Missouri Metallic Minerals Waste Management Act	RSMo 444.350 – 380 10CSR 45	Regulates disposal of waste from active metallic mineral mining, beneficiation, and processing. The regulations also contain technical guidelines, permitting, and closure requirements. Because these regulations contain closure standards for active metal mines, they are not ARARs but may be reviewed and considered during the design of removal actions. They are considered TBCs.		X
Missouri Land Reclamation Act - Industrial Mineral Law	RSMo 444.760 – 790 10 CSR 40.010	This law and regulations contain permitting and performance requirements for non-metal mining, surface and underground coal mining, in-stream sand and gravel, industrial mineral open pit mining, limestone, clay, etc. However, the law and implementing regulations are not applicable to chat recycling operations because chat piles are not natural formations. However, some of the surface mining standards are relevant and appropriate requirements because they address circumstances that are similar to those at chat recycling and quarrying operations in the Jasper County Site.	X	

Table 5 Federal and State Chemical-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARARs	To Be Considered
Missouri Clean Water Act – Chapter 8 – Design Guides – Regulations on Handling and Disposal of Municipal Sewage Sludge, Land Application	10 CSR 20-8.170, Section (9) Municipal Sludge Disposal on Land	These regulations contain Missouri's guidelines and requirements for disposing of municipal sewage sludge on land. The State's guidelines and requirements are less stringent and less comprehensive than the Federal regulations cited above (40 CFR Part 503) and are, therefore, likely not applicable. However, these regulations are considered relevant and appropriate requirements.	X	

Table 6 Federal and State, and Local Location-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARAR	To Be Considered
FEDERAL REQUIREMENTS				
Archaeological and Historic Preservation Act	16 USC Sec. 469 40 CFR Sec. 6.301(c)	Establishes procedures to provide for preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a Federally licensed activity or program.	X	
Archaeological Resources Protection Act	16 USC Secs. 470 aa - mm	Requires permits for any excavation or removal of archaeological resources from public or Indian lands. Provides guidance for Federal land managers to protect such resources.		X
National Historic Preservation Act	16 USC Sec. 470 40 CFR Sec. 6.301(b) 36 CFR Part 800 Executive Order 11593, May 3, 1971	Requires Federal agencies to take into account the effect of any Federally assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for Register of Historic Places.	X	
Historic Sites, Buildings, and Antiquities Act	16 USC Secs. 461-467 40 CFR Sec. 6.301(a)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	X	
Fish and Wildlife Coordination Act	16 USC Secs. 661-666 40 CFR Sec. 6.302(g)	Requires any Federal agency or permitted entity to consult with the U.S. Fish and Wildlife Service and appropriate state agency prior to modification of any stream or other water body. The intent of this requirement is to conserve, improve, or prevent loss of wildlife habitat and resources.	X	
Fish and Wildlife Conservation Act	16 USC Secs. 2901- 2912	Requires Federal agencies to utilize their statutory and administrative authority to conserve and promote conservation of non-game fish and wildlife species.		X
Endangered Species Act	16 USC Secs. 1531-1544 50 CFR Parts 17, 402 40 CFR Sec. 6.302(h)	Requires that Federal agencies insure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.	X	
Federal Migratory Bird Act	16 USC Secs. 703 - 712	Requires remedial actions to conserve habitat and consultation with the Department of Interior if any critical habitat is affected.	X	
Executive Order on Floodplain Management	Executive Order No. 11988 40 CFR Sec. 6.302(b) and Appendix A	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.		X
Executive Order on Protection of Wetlands	Executive Order No. 11990 40 CFR Sec. 6.302(a) and Appendix A	Requires Federal agencies to avoid, to the maximum extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid new construction in wetlands, if a practicable alternative exists.		X

Table 6 Federal and State, and Local Location-Specific ARARs and Guidance to be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARAR	To Be Considered
Farmland Protection Policy Act	7 USC Sec. 4201 *et. seq.* 40 CFR Sec. 6.302 (c)	Protects significant or important agricultural lands from irreversible conversion to uses that result in its loss as an environmental or essential food production resource.		X
RCRA – Location Standards for Hazardous Waste Facilities	42 USC Sec. 6901 40 CFR 264.18	Requires that any hazardous waste facility located within the 100-year floodplain be designed, constructed, operated, and maintained to avoid washout. Also, contains requirements for locating facilities away from seismically active zones.		X
Rivers and Harbors Act	33 CFR Secs. 320 - 330	Requires preapproval of the US Army Corps of Engineers prior to placement of any structures in waterways and restricts the placement of structures in waterways.		X
STATE REQUIREMENTS				
Missouri Wildlife Code	3 CSR Sec.10 – 4.111	Requires a determination of the presence or absence of endangered or threatened species, and provides for regulation of non-game wildlife. Places restrictions on actions affecting protected species.	X	

Table 7 Comparative Analysis of Remedial Alternatives with Respect to Long-Term Effectiveness and Permanence Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal and On-Site Aboveground Disposal and Water Treatment
Magnitude of Residual Risks	Approximately 5,000 acres of land require institutional controls to manage residual human health risks. Residual risks to vermivores are highest under Alternative 1 because large areas of mill waste exceed RBCs. The source material RAO is not achieved. In fact, risks to vermivores may increase over time as more excavated barren chat areas becomes vegetated. Residual risks to aquatic life are highest under Alternative 1 because surface water ARARs are exceeded and the RAOs are not achieved. Residual seepage from mill wastes is highest with a predicted annual site-wide seepage of 240 million CF/year.	At full implementation under Alternative 2, approximately 1,139 acres of land require institutional controls. At full implementation, approximately 180 acres of tailings exceed RBCs. Hence, the source material RAO may not be met, as residual risks to terrestrial vermivores still exist. In fact, risks may be increased in some revegetated source materials compared to other alternatives, if biosolids prove ineffective in reducing metals bioavailability. Surface water RAOs are not fully achieved, as ARARs continue to be exceeded under some conditions posing residual risks to aquatic life. Compared to current conditions (Alternative 1), residual mill waste seepage is reduced by 84% to 39 million CF/year. Full implementation under Alternative 2 requires up to 30 years.	Under Alternative 3, approximately 1,700 acres of land require institutional controls to manage residual human health risks at full implementation. In contrast to Alternatives 1 and 2, the source. material RAO is achieved under Alternative 3 because potential exposure pathways are addressed. Surface water RAOs are not fully achieved, as ARARs continue to be exceeded under some conditions posing residual risks to aquatic life. Compared to current conditions (Alternative 1), residual mill waste seepage is reduced by 80% to 48 million CF/year. Full implementation of Alternative 3 requires up to 12 years.	At full implementation, only 710 acres are subject to institutional controls to manage residual human health risks. Source material and surface water RAOs are fully achieved. Residual risks to terrestrial vermivores and aquatic life are negligible. Compared to current conditions (Alternative 1), residual millwaste seepage is reduced by 90% to 24 million CF/year. Full implementation of Alternative 4 can be achieved in 7 years.	Approximately 1,080 acres are subject to institutional controls to manage residual human health risks at full implementation under Alternative 5a. Source material and surface water RAOs are fully achieved. Residual risks to terrestrial vermivores and aquatic life are negligible. Compared to current conditions (Alternative 1), residual mill waste seepage is reduced by 90% to 24 million CF/year. Full implementation of Alternative 5a can be achieved in 7 years.	Only 280 acres are subject to institutional controls to manage residual human health risks at full implementation under Alternative 5b, the lowest of any alternative. Source material and surface water RAOs are fully achieved. Residual risks to terrestrial vermivores and aquatic life are negligible. Residual mill waste seepage is practically eliminated under Alternative 5b. Full implementation of Alternative 5b can be achieved In 5 years.

Table 7 Comparative Analysis of Remedial Alternatives with Respect to Long-Term Effectiveness and Permanence Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal and On-Site Aboveground Disposal and Water Treatment
Adequacy and Reliability of Controls	The extent of environmental risk management under Alternative 1 is inadequate for achieving the RAOs. Alternative 1 affords no enhancement of existing institutional controls implemented under other OUs for the protection of human health. No long-term management or maintenance is required under Alternative 1, but monitoring continues indefinitely.	Infiltration and seepage from mill wastes directly revegetated using biosolids is higher under this alternative than the options prescribed under any other action alternatives. Direct revegetation, as prescribed under Alt. 2 is considered the least permanent cover option of any alternatives. However, chat recycling is considered highly permanent and reliable for reducing the volume of source materials remaining on Site. The adequacy and reliability of the treatment effect of biosolids in reducing bioavailability to terrestrial vermivores is uncertain. However, deep tilling of vegetated chat and transition zone soils is considered adequate for reducing metal concentrations below RBCs, thereby reducing risks to vermivores. Under Alternative 2, interim management of consolidated waste piles may be required up to 30 years	Less infiltration and seepage results from the waste piles capped with simple soil covers under Alt. 3 than the directly revegetated piles under Alt. 2. However, simple soil covers are less effective at preventing infiltration than the geo-composite cover systems prescribed under Alt. 4, 5a, and 5b. Simple soil covers are considered a more permanent, and reliable than Alt. 1 and 2, but less permanent and reliable than subsidence pit disposal or the engineered repositories prescribed under Alt 4, 5a and 5b. Under Alternative 3, interim management of consolidated waste piles is required up to 10 years. No long-term maintenance of capped waste piles, except institutional controls, is required at full implementation.	The geo-composite cover system installed on the filled subsidence pits is the most effective cover option, as it nearly eliminates surface infiltration into the disposed mill wastes. However, the cover system would require maintenance. Subsidence pit disposal, as prescribed under Alternative 4 is considered the most permanent and reliable method available for the long-term management of mill wastes. Long-term management of the capped subsidence pits consists of restricting future land uses an estimated 710 acres.	The geo-composite cover systems nearly eliminate surface infiltration and seepage but would require maintenance, the same as Alternatives 4 and 5b. Since the repositories are aboveground, they are considered somewhat less permanent than subsidence pit disposal. Long-term management of the aboveground repositories consists of restricting future land uses an estimated 1,080 acres.	Same as Alternative 5a. However, maintenance of the repository cover systems is limited to 280 acres. The passive anaerobic treatment systems prescribed under this alternative are innovative and their long-term reliability is not fully tested. Also, the requirements for long-term monitoring and possible replacement of the organic substrate in the anaerobic treatment systems are unique to this alternative.

Table 8 Comparative Analysis of Remedial Alternatives with Respect to Short-Term Effectiveness Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal and On-Site Aboveground Disposal and Water Treatment
Protection of the Community During Remedial Actions	Risks to the community are the same as under current conditions.	Potential risks to the community under Alt. 2 are the same as under all other action alternatives. These potential risks are readily mitigated through appropriate traffic safety, dust control, and public involvement measures. Risks to local communities caused by biosolids applications may be negligible, if application complies with EPA regulations. However, public perception of risks may be high.	Same as Alternative 2.	A larger amount of source materials are hauled within DAs than under Alternatives 2 or 3. Truck traffic and dust generation are more intense for a short period (7 years). Potential risks to the local community will be higher during this period than under Alternatives 2 or 3.	Same as Alternative 4.	Same as Alternative 4. However, more materials are hauled longer distances outside the DAs than any other action alternative. Truck traffic and dust generation will be more intense for a short period (5 years). Potential risks to the local community will be higher during this period than under other alternatives.
Protection of Workers During Remedial Actions	No additional risks to workers are experienced under the no further action alternative.	Risks to workers are the same under Alternative 2 as under all other action alternatives, except Alternative 4. These risks can be reduced through appropriate worker health and safety training, design, and planning.	Same as Alternative 2.	Risks to workers are the same under other action alternatives. However, workers are exposed to increased risks due to the physical hazards of filling the subsidence pits. Additional measures to evaluate and mitigate these hazards will be needed that are unique to this alternative.	Same as Alternative 2.	Same as Alternative 2.

Table 8 Comparative Analysis of Remedial Alternatives with Respect to Short-Term Effectiveness Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Re vegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal and On-Site Aboveground Disposal and Water Treatment
Potential Environmental Impacts Caused by the Remedial Actions	Risks to the environment are the same as under current conditions.	Potential environmental impacts caused by excavating mill wastes and sediments from riparian areas and wetlands are the same under this alternative as under all other alternatives. Excessive nutrient loading to surface waters is a potential impact unique to Alts. 2 and 3. This potential impact can be mitigated by composting, multiple applications, and avoiding applications near surface water bodies. Alt. 2 remediates an estimated 2,100 acres of land to usable condition by consolidating and recycling source materials.	Same as Alternative 2. Soil loss due to extensive construction of soil covers impacts the environment by depleting non-renewable soil resources. Alternative 3 results in the greatest amount of soil depletion (>2 million) CY than any other action alternative. Alternative 3 remediates an estimated 1,500 acres of land to usable condition by consolidating and recycling source materials.	A short-term release of metals to groundwater unique to Alt. 4 occurs when mill wastes are placed in subsidence pits. These metals releases localized, and have no affect on surface water quality or on groundwater quality distant from the mine workings. Aquatic habitat may be lost by placing wastes in subsidence pits. Habitat loss is minimized by selecting disposal sites with low value habitat. Loss of non-renewable soil resources is significantly less under this alternative than under Alt. 3, as the amount of borrow soil used is minimal by comparison. Alt. 4 remediates an estimated 2,500 acres of land to usable condition by disposing of source materials in pits.	More soil (>1 million CY) is used under this alternative than under Alternative 4. However, the loss of non-renewable soil resources is half that of Alternative 3. Alternative 5a remediates an estimated 1,500 acres land to usable condition by disposing of source materials in on-site repositories.	Same as Alternative 5a, but less borrow soil (670,000 CY) Is needed to implement Alternative 5b because of the greater level of repository centralization. Alternative 5b remediates the greatest amount (an estimated 3,000 acres) of land to usable condition than any other action alternative.

Table 8 Comparative Analysis of Remedial Alternatives with Respect to Short-Term Effectiveness Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal and On-Site Aboveground Disposal and Water Treatment
Time Until RAOs Are Achieved	RAOs are not achieved under Alternative 1.	Initial response actions are completed within 5 years. Full implementation is achieved within 30 years. However, source material and surface water RAOs may not be fully achieved at full implementation.	Initial response actions are completed within 5 years. Full implementation is achieved within 12 years. However, surface water RAOs may not be fully achieved at full implementation.	All RAOs are achieved within 7 years of the start of remedial actions.	All RAOs are achieved within 7 years of the start of remedial actions.	All RAOs are achieved within 5 years of the start of remedial actions.

Table 9 Comparative Analysis of Remedial Alternatives with Respect to Reduction of Toxicity, Mobility, or Volume Through Treatment Jasper County, Missouri

Criterion	**Alternative 1** No Further Action	**Alternative 2** Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	**Alternative 3** Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	**Alternative 4** Source Removal and Subsidence Pit Disposal	**Alternative 5a** Source Removal and On-Site Aboveground Disposal	**Alternative 5b** Source Removal and On-Site Aboveground Disposal and Water Treatment
Treatment Process Used and Materials Treated	Chat recycling may result in treatment, but uncontrolled recycling and use of chat, as currently practiced, is not considered effective or reliable treatment.	Controlled chat recycling under Alternative 2 meets the objectives of treatment by incorporating chat into asphalt or concrete or by chat washing. Chat that is not treated is effectively contained by use as fill materials that prevent exposure or metals transports .	Same as Alternative 2 Alternative 3 does not rely on treatment to reduce mobility and bioavailability of in metals in vermivores, as in Alternative 2.	Subaqueous mill waste disposal results in remineralization of metal oxides as insoluble sulfides. This reduces the mobility of the metals.	On-site aboveground disposal would not result in TMV reductions through treatment.	All chat recycling is precluded under Alternative 5b. Treatment occurs in passive anaerobic treatment systems reducing metals mobility. No biosolids are used under Alternative 5b.
Amount of Materials Treated	None.	None.	None.	Approximately 3.8 million CY are treated by reducing conditions in the capped subsidence pits.	None.	Metal loads addressed by the passive anaerobic treatment systems are minor.
Effectiveness and Irreversibility of Treatment	None.	Reductions in TMV achieved by chat recycling are effective and irreversible. The irreversibility and long-term effectiveness of treatment effects from biosolids additions are currently being investigated.	Same as Alternative 2.	Reductive remineralization is highly effective in reducing metal mobility. However, insoluble sulfide minerals can be reoxidized if exposed to weathering conditions.	Same as Alternative 2.	Remineralization that occurs in passive anaerobic treatment systems is highly effective in reducing metal mobility. However, insoluble sulfide minerals can be re-oxidized if re-exposed to weathering conditions.

Table 9 Comparative Analysis of Remedial Alternatives with Respect to Reduction of Toxicity, Mobility, or Volume Through Treatment Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal and On-Site Aboveground Disposal and Water Treatment
Treatment Residuals Generated	No treatment residuals are generated under Alternative 1.	No treatment residuals are generated under Alternative 2.	Same as Alternative 2.	No treatment residuals are generated under Alternative 4.	Same as Alternative 4.	Treatment residuals consist of spent organic substrate from the anaerobic treatment systems. The metals immobilized by the treatment process remain in the substrate. Hence, disposal as a hazardous waste may be required.

Table 10 Comparative Analysis of Remedial Alternatives with Respect to Implementability Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal and On-Site Aboveground Disposal and Water Treatment
Technical Feasibility – Constructibility and Reliability of Prescribed Technologies	All the actions described under Alternative 1 are implementable.	Engineering controls prescribed under Alt. 2 technically feasible and readily constructible. Additional remedial measures are readily implementable, if needed, under Alt. 2.	Same as Alternative 2.	Same as Alternative 2. However, undertaking additional remedial measures would be extremely difficult, if not impossible under Alt. 4.	Same as Alternative 2.	Same as Alternative 2. The passive anaerobic treatment systems are constructible but innovative.
Administrative Feasibility	The greatest level of coordination among federal, state, or local agencies is required under Alt.1 because the most land area is subject to institutional controls. Alt.1 relies on institutional controls to manage residual risks. Institutional controls may preclude landowners from fully utilizing lands affected by mill wastes. Alternative 1 is the most restrictive in terms of limiting the flexibility of future land uses.	Administration of institutional controls requires less coordination compared with Alternative 1. Landowner access agreements and easements are expected to be facilitated under Alternative 2 by allowing continued chat recycling for a longer period of time than other alternatives. Alternative 2 allows greater flexibility of future land uses compared with Alternatives 1 and 3, but less than Alternatives 4, 5a, and 5b.	Approximately 1,700 acres of land are subject to institutional controls. Hence, Alternative 3 requires more administrative coordination than Alternatives 2, 4, 5a, or 5b. Alternative 3 requires the same level of coordination as Alternative 2 to effectively implement controls on chat recycling. Landowner access agreements and easements are expected to be facilitated under Alternative 3 by allowing continued chat recycling for a longer period of time	710 acres are subject to institutional controls under Alternative 4, thereby reducing administrative coordination compared with Alternatives 1, 2, 3, and 5a. Coordination of maintenance and deed restrictions is required on about 90 acres of subsidence pit covers under Alternative 4, less than under either Alternatives 5a or 5b. Alternative 4 is dependent on coordination and cooperation with local land owners. However, private property issues due to	Approximately the same level of coordination between EPA and local landowners is needed for Alternative 5a as Alternative 4 or 5b. Permanent easements needed for repositories will preclude other land uses on an estimated 460 acres. This may require actual fee simple acquisition of the sites. Alternative 5a is dependent on coordination and cooperation with local land owners. However, private property issues due to early curtailment of chat recycling may present an	Same as Alternative 5a. However, Alternative 5b allows the greatest level of flexibility of future land uses, as only 280 acres are permanently affected.

Table 10 Comparative Analysis of Remedial Alternatives with Respect to Implementability
Jasper County, Missouri

Criterion	**Alternative 1** No Further Action	**Alternative 2** Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	**Alternative 3** Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	**Alternative 4** Source Removal and Subsidence Pit Disposal	**Alternative 5a** Source Removal and On-Site Aboveground Disposal	**Alternative 5b** Source Removal and On-Site Aboveground Disposal and Water Treatment
Administrative Feasibility (continued)			than other alternatives, except Alternatives 1 and 2. Alternative 3 allows less flexibility of future land uses compared with Alternatives 2, 4, 5a and 5b, but greater than Alternative 1.	early curtailment of chat recycling may present an obstacle to landowner cooperation and implementability. Alternative 4 allows greater flexibility of future land uses compared with Alternatives 1, 2, 3, or 5a but less than Alternative 5b.	obstacle to landowner cooperation and implementability. Alternative 5a allows less flexibility of future land uses compared with Alternatives 2, 4, and 5b, but greater than Alternatives 1 and 3.	
Availability of Labor and Materials	All services and materials are readily available.	Biosolids availability within a reasonable distance from the Site is limited to about 20 to 40 dry tons per day. Under Alternative 2, biosolids supplies limit the rate at which mill waste deposits can be remediated.	A large quantity of soil is needed to implement Alternative 3. While the soils are available locally, using such large quantities of this non-renewable resource may deplete the locally available supplies. Biosolids availability is not a rate limiting factor because the reliance on soil covers proposed under Alternative 3 reduces the quantity of biosolids needed.	Equipment, technologies, and skilled workers needed to implement Alternative 4 are readily available. Smaller quantities of cover soils are required for capping the filled subsidence pits than under Alternatives 5a and 5b. Transition zone soils and soils beneath waste piles to be excavated are sufficient for construction of the soil covers under Alternative 4.	Equipment, technologies, and skilled workers needed to implement Alternative 5a are readily available. Larger quantities of cover soils are required for capping the on-site repositories under Alternative 5a than under Alternatives 4 or 5b. However, transition zone soils and soils beneath waste piles to be excavated are sufficient for construction of the soil covers under Alternative 5a.	Equipment, technologies, and skilled workers needed to implement Alternative 5b are readily available. Smaller quantities of cover soils are required for capping the under this alternative compared to Alt. 5a but more than Alt. 4. Transition zone soils and soils beneath waste piles are sufficient for construction of the soil covers.

Table 11 Comparative Analysis of Remedial Alternatives with Respect to Cost
Jasper County, Missouri

Criterion	Alternative 1 No Further Action	Alternative 2 Source Consolidation, In-Place Containment through Revegetation Using Biosolids, and Recycling	Alternative 3 Source Consolidation, In-Place Containment Using Simple Soil Covers, Revegatation, and Recycling	Alternative 4 Source Removal and Subsidence Pit Disposal	Alternative 5a Source Removal and On-Site Aboveground Disposal	Alternative 5b Source Removal and On-Site Aboveground Disposal and Water Treatment
Capital Cost	None	$44,312,000	$77,112,000	$58,543,000	$93,707,000	$81,296,000
Annual Operation and Maintenance	$9,700	$101,000	$83,600	$22,500	$137,000	$102,000

Table 12 Detailed Cost Analysis for Alternative 4

Item No.	Item Description	Estimated Quantity	Units	Unit Price	Total Est. Cost	Comments and Assumptions
1.	**Excavate and Dispose of In/Near Stream Chat Sediment Sources in On-Site Subsidence Pits**					
	a. Excavate and load chat	2150761	cu.yds.	$3.50	$7,527,664	Actual cost from 2002 Cherokee County remedial action.
	b. Transport and dump chat in subsidence pits	2150761	cu.yds.	$0.45	$967,842	Assumes a 2 mile roundtrip haul.
	c. Excavate and haul cover soils	107448	cu.yds.	$8.80	$945,542	Assume 18 in. of borrow soil hauled 10 miles roundtrip
	d. Place and lightly compact cover soils	107448	cu.yds.	$1.82	$195,555	
	e. Furnish and install GCL liner material	214896	sq.yds.	$5.40	$1,160,438	Assume Bentomat or equivalent material
	f. Furnish and install drainage fabric	214896	sq.yds.	$2.25	$483,516	
	g. Revegetate geo-composite cover system	44.4	acres	$1,285.00	$57,102	Assume hydroseeding with mulch
	h. Install drainage and erosion controls	4929	lin.ft.	$7.60	$37,458	Assume staked hay bales not replaced after reveg.
	i. Deep till excavated area	863.8	acres	$720.00	$621,936	
	j. Add organic matter to excavated areas	8638	tons	$30.00	$259,140	Assume 10 tons organic matter/acre, spread and tilled
	k. Revegetate excavated area	863.8	acres	$1,285.00	$1,109,983	Assume hydroseeding with mulch
	Subtotal Chat Disposal	**$13,366,177**				
2.	**Excavate and Dispose of In/Near Stream Tailings and Tailings Sediment Sources in On-Site Subsidence Pits**					
	a. Excavate and load tailings	324315	cu.yds.	$3.90	$1,264,829	Actual cost from Waco study, short haul with scrapers.
	b. Transport and dump tailings in subsidence pits	324315	cu.yds.	$0.45	$145,942	Assumes a 2 mile roundtrip haul.
	c. Excavate and haul cover soils	16214	cu.yds.	$8.80	$142,683	Assume 18 inches of borrow soil hauled 5 miles it.
	d. Place and lightly compact cover soils	16214	cu.yds.	$1.82	$29,509	
	e. Furnish and install GCL liner material	32428	sq.yds.	$5.40	$175,111	Assume Bentomat or equivalent material
	f. Furnish and install drainage fabric	32428	sq.yds.	$2.25	$72,963	
	g. Revegetate geo-composite cover system	6.7	acres	$1,285.00	$8,610	Assume hydroseeding with mulch
	h. Install drainage and erosion controls	1915	lin.ft.	$7.60	$14,551	Assume staked hay bales not replaced after reveg.
	I. Deep till excavated area	263.8	acres	$720.00	$189,936	
	j. Add organic matter to excavated areas	2638	tons	$30.00	$79,140	Assume 10 tons organic matter/acre, spread and tilled
	k. Revegetate excavated area	263.8	acres	$1,285.00	$338,983	Assume hydroseeding with mulch
	Subtotal In/Near Stream Tailings Consolidation	**$2,462,257**				
3.	**Excavate and Dispose Upland Chat in On-Site Subsidence Pits**					
	a. Excavate and load chat	1626229	cu.yds.	$3.50	$5,691,802	Actual cost from 2002 Cherokee County remedial action
	b. Transport and dump chat in subsidence pits	1626229	cu.yds.	$0.45	$731,803	Assumes a 2 mile roundtrip haul.
	c. Excavate and haul cover soils	81311	cu.yds.	$8.80	$715,541	Assume 18 in. of borrow soil hauled 5 miles it.
	d. Place and lightly compact cover soils	81311	cu.yds.	$1.82	$147,987	
	e. Furnish and install GCL liner material	162623	sq.yds.	$5.40	$878,164	Assume Bentomat or equivalent material
	f. Furnish and install drainage fabric	162623	sq.yds.	$2.25	$365,902	
	g. Revegetate geo-composite cover system	33.6	acres	$1,285.00	$43,176	Assume hydroseeding with mulch
	h. Install drainage and erosion controls	4288	lin.ft.	$7.60	$32,585	Assume staked hay bales not replaced after reveg.
	i. Deep till excavated area	1180	acres	$720.00	$849,600	
	j. Add organic matter to excavated areas	11800	tons	$30.00	$354,000	Assume 10 tons organic matter/acre, spread and tilled
	k. Revegetate excavated area	1180	acres	$1,285.00	$1,516,300	Assume hydroseeding with mulch
	Subtotal Upland Chat	**$11,326,858**				

Table 12 Detailed Cost Analysis for Alternative 4

4.	**Excavate In/Near -Stream Veg'd Chat and Veg'd Chat Sed. Sources and Dispose of in On-Site Subsidence Pits**					
	a. Clear and grub veg'd chat areas	258.1	acres	$2,000.00	$516,200	Actual cost from 2002 Cherokee County remedial action
	b. Excavate and load chat	225296	cu.yds.	$3.50	$788,536	Actual cost from 2002 Cherokee County remedial action
	c. Transport and dump chat in subsidence pits	225296	cu.yds.	$0.45	$101,383	Assumes a 2 mile roundtrip haul.
	d. Excavate and haul cover soils	11265	cu.yds.	$8.80	$99,130	Assume 18 in. of borrow soil hauled 5 miles it.
	e. Place and lightly compact cover soils	11265	cu.yds.	$1.82	$20,502	
	f. Furnish and install GCL liner material	22530	sq.yds.	$5.40	$121,660	Assume Bentomat or equivalent material
	g. Furnish and install drainage fabric	22530	sq.yds.	$2.25	$50,692	
	h. Revegetate geo-composite cover system	4.7	acres	$1,285.00	$5,982	Assume hydroseeding w ith mulch
	i. Install drainage and erosion controls	1604	lin.ft.	$7.60	$12,187	Assume staked hay bales not replaced after reveg.
	j. Deep till excavated area	258.1	acres	$720.00	$185,832	
	k. Add organic matter to excavated areas	2581	tons	$30.00	$77,430	Assume 10 tons organic matter/acre, spread and tilled
	l. Revegetate excavated area	258.1	acres	$1,285.00	$331,659	Assume hydroseeding with mulch
	Subtotal In/Near Veg'd Chat, etc.	**$2,311,192**				
5.	**Excavate and Dispose of Acidic Overburden in Wild Goose Pit**					
	a. Excavate and load overburden	335700	cu.yds.	$3.90	$1,309,230	Actual cost from Wacostudy, short haul with scrapers.
	b. Transport and dump overburden in subsidence pits	335700	cu.yds.	$0.45	$151,065	Assumes a 2 mile roundtrip haul.
	c. Deep till excavated area	39	acres	$720.00	$28,080	
	d. Add organic matter to excavated areas	390	tons	$30.00	$11,700	Assume 10 tons organic matter/acre, spread and tilled
	e. Revegetate excavated area	39	acres	$1,285.00	$50,115	Assume hydroseeding with mulch
	f. Excavate and place soils for berm around pit	4500	cu.yds.	$6.24	$28,080	Assume an earthen berm 4 ft. high (1.2 cy/lin.ft)
	g. Construct lined diversion channel	3750	lin.ft.	$3.03	$11,363	Assume 60 mil HOPE liner under soil cover
	h. Construct open limestone drain	750	sq.yds.	$65.00	$48,750	Limestone cobbles placed in natural drainage channel
	Subtotal Acidic Overburden	**$1,638,383**				
6.	**Deep Till Upland Veg'd Chat, Add Biosolids and Revegetate**					
	a. Deep till upland veg'd chat	617.7	acres	$1,720.00	$1,062,444	Includes some clearing and grubbing.
	b. Add biosolids to upland veg'd chat	46327.5	dry tons	$30.00	$1,389,825	Assume 75 dry tons biosolids per acre
	c. Add lime to upland veg'd chat	6177	tons	$12.75	$78,757	Assume 10 tons of lime per acre
	d. Revegetate tilled upland veg'd chat	617.7	acres	$1,285.00	$793,745	Assume hydroseeding with mulch
	Subtotal Upland Veg'd Chat	**$3,324,770**				
7.	**Excavate Transition Zone Soils Exceeding Risk-Based Criteria and Use for Cover Soil**					
	a. Excavate and load T-zone soils	217800	cu.yds.	$0.00	$0	Costs included in No. 1, 2, and 3 above.
	b. Transport and place T-zone soils on covers	217800	cu.yds.	$0.00	$0	Costs included in No. 1, 2, and 3 above.
	c. Deep till excavated area	135	acres	$720.00	$97,200	
	d. Add organic matter to excavated areas	1350	tons	$30.00	$40,500	Assume 10 tons organic matter/acre, spread and tilled
	e. Revegetate excavated area	135	acres	$1,285.00	$173,475	Assume hydroseeding with mulch
	Subtotal In/Near Stream T-Zone Soils	**$311,175**				

Table 12 Detailed Cost Analysis for Alternative 4

8.	**Deep Till Remaining T-Zone Soils Exceeding Risk Based Criteria, Add Biosolids and Revegetate**					
	a. Deep till T-zone soils	1337	acres	$1,220.00	$1,631,140	Includes light clearing and grubbing.
	b. Add biosolids to T-zone soils	13370	dry tons	$30.00	$401,100	Assume 10 dry tons biosolids per acre
	c. Add lime to T-zone soils	13370	tons	$12.75	$170,468	Assume 10 tons of lime per acre
	d. Revegetate tilled T-zone soils	1337	acres	$1,285.00	$1,718,045	Assume hydroseeding with mulch
	Subtotal Upland T-Zone Soils	**$3,920,753**				
9.	**Excavated Bed and Bank Sediments and Dispose of in Subsidence Pits**					
	a. Excavate sediments	8900	cu.yds.	$3.90	$34,710	Actual cost from Waco study, short haul with scrapers
	b. Transport and place sediments in waste cells	8900	cu.yds.	$0.45	$4,005	Assumes a 2 mile roundtrip haul.
	c. Restore excavated areas	20459	lin.ft.	$10.00	$204,590	Best guess
	Subtotal Sediments	**$243,305**				
10.	**Implement Drainage and Erosion Controls**					Total approximate length = 74,000 lin.ft.
	a. Install riprap revetment - ungrouted	16444	sq.yds.	$65.00	$1,068,889	Assume 10 percent of total length
	b. Install berms	54815	cu.yds.	$6.20	$339,852	Assume 20 percent of total length
	c. Regrade excavated areas	164444	sq.yds.	$1.85	$304,222	Assume total area fine graded, small irregular areas.
	d. Install geotextile erosion control material	41111	sq.yds.	$1.21	$49,744	Assume 25 percent of total
	e. Revegetate excavated areas	34.0	acres	$1,285.00	$43,659	Assume hydroseeding with mulch
	Subtotal Drainage and Erosion Controls	**$1,806,367**				
11.	**Install Adit Plugs and Drainage Ditches**					
	a. Install adit plugs	100	each	$10,000.00	$1,000,000	Best guess
	b. Install upgradient diversion ditches	50000	lin.ft.	$13.25	$662,500	Best guess
	c. Head walls, berms, riprap, etc.	1	lump sum	$500,000.00	$500,000	Best guess
	Subtotal Adit Plug and Diversion Ditches	**$2,162,500**				
12.	**Institutional Controls**					
	a. Health Education	10	years	$125,000.00	$1,250,000	
	b. Health ordinance - building code	10	years	$60,000.00	$600,000	
	Subtotal Institutional Controls	**$1,850,000**				
13.	**Indirect Capital Costs**					
	a. Negotiate landowner agreements	1	lump sum	$100,000	$100,000	Assume 1% of total direct capital cost
	b. Remedial design	1	lump sum	$2,143,687	$2,143,687	Assume 5% of total direct capital cost
	c. Construction oversight and management	1	lump sum	$3,001,162	$3,001,162	Assume 7% of total direct capital cost
	d. Contingencies	1	lump sum	$8,574,747	$8,574,747	Assume 20% of total direct capital cost
	Subtotal Indirect Costs	**$13,819,596**				
	Total Alternative 4 Capital Costs				**$58,543,332**	
14.	**Annual Operation and Maintenance Costs**					
	c. Monitoring and maintenance of repository caps	90	acres	$250.00	$22,500	
	Subtotal Annual O&M Costs – Alternative 4	**$22,500**				

Table 12 Detailed Cost Analysis for Alternative 4

Biosolids costs assume cake with 20% solids at $6.00 per wet ton delivered and applied.
Note: Total transportation and application costs per dry ton are $30.00.
1. Source: Brown *et al.* 2001, and Ed Malters, City of Springfield, Mo.

Lime costs assume agricultural lime at $5.75 per ton plus $7.00 transportation and spreading.
Source: Brown *et al.* 2001.
2.
A total of 66,725 dry tons of biosolids are applied under this alternative. This represents
9.1 years of total daily production of Springfield, Mo., at the current rate of 20 dry tons per day.
3.
Geo-composite cover systems consist of 18 inches of soil, a GCL, and drainage layer placed over the wastes and revegtated.
Approximatley7 217,8000 cubic yards of cover soils are needed to implement Alternative 4. This volume of soil
4. can be obtained from transition zone soils. Capped areas cover approximately 89.4 acres.

Alternative 4 assumes approximately 25 percent of upland chat (543,000 cubic yards) is removed by recycling.

5. The present worth analysis assumes 30 years of O&M at a discount rate of 3 per cent. Direct capital costs are spread evenly throughout
years 2 through 7 when remedial actions are assumed to be completed. Indirect costs are spread out over the first 6 years of remediation.
6. The first 5 years of O&M costs reflect administration of landowner agreements, but are reduced and distributed evenly over last 25 years of the present worth period.

Appendix A

Responsiveness Summary

RESPONSIVENESS SUMMARY

OPERABLE UNIT 1
MINE AND MILL WASTE
ORONOGO-DUENWEG MINING BELT SITE
JASPER COUNTY MISSOURI

Introduction

This Responsiveness summary has been prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act, and the National Contingency Plan (NCP) 40 CFR § 300.430(f). This document provides the United States Environmental Protection Agency's (EPA) response to all significant comments received on the Proposed Plan from the public during the 30-day comment period.

On July 19, 2004, the EPA released the Proposed Plan and Administrative Record File containing pertinent documents for cleanup of OU-1 for public review and comment. The Proposed Plan discussed the EPA's proposed action to address Oronogo-Duenweg Mining Belt site (Site) source materials contaminated with lead and cadmium. The public comment period was open from July 19 to August 19, 2004. The EPA held a public meeting on August 3 at Missouri South State College in Joplin, Missouri, to present the Proposed Plan and discuss results of investigations and feasibility study. A copy of the transcript from the public meeting is included in the Administrative Record File.

Comments Received from the Public and Responses

The following comments were received in writing during the public comment period.

Several comments were received from the Kansas Department of Health (KDHE) and Environment and the Oklahoma Department of Environmental Quality (ODEQ) regarding their concern that the EPA is not specifying the removal of contaminated sediments from Class P streams in the Site. Both state agencies are concerned that contaminated sediments from Missouri streams will migrate into their respective states, which will impair surface water quality to the point where Water Quality Criteria cannot be met. The EPA provides the following response to those concerns.

During 2003, the EPA and the potentially responsible party (PRP) assessed and analyzed sediment bar deposits in Turkey, Center, and Shoal Creeks. Lead and zinc concentrations in Shoal Creek deposits range from 100 to 500 parts per million (ppm) lead and 800 to 1900 ppm zinc. Lead and zinc concentrations in Center Creek deposits range from 100 to 500 ppm lead and 1300 to 2900 ppm zinc. Lead and zinc concentrations in Turkey Creek deposits range from 300 to 500 ppm lead and 1700 to 3700 ppm zinc. During the Remedial Investigation, conducted from 1991 to 1995, stream sediment samples in Spring River, Turkey, Short, and Center Creeks were collected and analyzed. The results indicated the sediment concentrations in Spring River meet the EPA's sediment values at the locations sampled in Missouri at 1 to 1.4 ppm cadmium, 15 to 20 ppm lead, and 100 to 250 ppm zinc. Background concentrations, upstream of the Site designated areas were 1.4 ppm cadmium, 20 ppm lead and 250 ppm zinc. Sediments in Turkey Creek contained 13 to 19 ppm cadmium, 60 to 240 ppm lead, and 1070 to 4800 ppm zinc. Sediments in Center Creek contained 0.6 to 68 ppm cadmium, 17 to 240 ppm lead, and 120 to 2870 ppm zinc. Sediments in Short Creek contained 17 to 19 ppm cadmium, 60 to 180 ppm lead, and 3100 to 3500 ppm zinc.

The EPA has established sediment cleanup criteria in the OU-1 ROD for tributaries to the Class P streams and delta deposits at the mouths of these tributaries for the Site at 2 ppm cadmium, 70 ppm lead, and 250 ppm zinc. The removal of a significant volume of sediments from the tributaries during non-flowing periods is planned. Theses actions would only take place following remediation of the erodable uplan and near-stream deposits of mill wastes in the watersheds. However, the data reported above indicates that, with the exception of Spring River (which is close to the action level for zinc even at the upstream, background location) all reaches of the Site streams exceed the cleanup criteria for cadmium, lead, and zinc. In order to fully meet the cleanup criteria for sediments in the short term, all sediments from Turkey, Center, Short, and Shoal Creeks would have to be removed throughout the entire Site, and possibly significant reaches of Spring River. This would result in the removal of nearly 60 miles of stream sediments, excluding the Spring River.

The EPA is not recommending removal of sediments in the Site Class P stream for the reasons listed below.

- The remedial action objectives developed for the remedial action at the Site specify cleanup of source material to achieve federal water quality standards in the Class P streams. Modeling conducted during the feasibility study process indicated the water quality in the streams would meet those criteria with a 90% reduction in loading to the streams via the tributaries. The EPA believes the federal standards for surface water quality can be achieved through the actions specified in the ROD without total sediment removal in the Class P streams. Or conversely, under post-remedy conditions, the EPA does not believe that the remaining sediments in Class P streams, as a metals source, are sufficiently mobile that they would independently cause an exceedance of federal water quality standards.

- Sediment metals concentrations in the Class P streams are relatively homogenous throughout their reaches. Any cleanup to remove the sediments exceeding cleanup criteria would involve total sediment removal. This would result in destruction of the habitat in the steam channels, and possibly significant damage to the riparian habitat during stream access for the removal of sediments. Furthermore, total sediment removal would adversely affect stream geomorphology due to changes in the sediment balance, potentially causing erosion problems.

- Habitat range for the Neosho Madtom, a federally listed endangered species, includes the Class P streams in Missouri. Neosho Madtom individuals have been found in the Spring River in Missouri. Viable habit for the Madtom exists in Center and Shoal Creeks.

Destruction of habitat for this organism would be unacceptable to the EPA and the fish and wildlife agencies with jurisdiction for this area.

- U.S. Fish and Wildlife Service and the Missouri Department of Conservation have expressed to the EPA that destruction of habitat, and the subsequently long recovery period, is not an acceptable tradeoff for meeting surface water quality throughout the entire reaches of the streams.

- Stream sediment removal is very difficult to achieve without significant release and remobilization of suspended particles downstream. Total sediment removal in the Class P steams at the Site would likely result in a massive short-term release of sediments downstream to Kansas and Oklahoma.

- Currently sediments in the bar deposits, visible above the low water mark in the Class P stream appear relatively stable. Generally the bars consist of large gravel to cobble size particles with 15 to 30 percent sand or finer fractions. Most bars appear well armored with very coarse gravel and cobbles, and are generally well vegetated with many deposits containing large mature trees. The physical conditions of the sediment deposits visible in the streams indicate they are not subject to any significant erosion, even under high flow conditions. A significant reduction in mobile sediments (bedload) is anticipated as a result of the actions prescribed in the ROD.

- The cleanup action selected in the ROD will result in the removal and disposal of all mine and mill waste sediment sources to the Class P streams. Future sediment loading from mined areas to the steams will be mitigated. However, flood-plain and upland soils will remain that contain metals concentrations below the EPA's cleanup standards but exceeding the sediment criteria. These flood-plain soils have potential to erode into the streams during flooding, which could potentially re-contaminate streams which were remediated. Preventing this situation would require removal of all flood-plain soils, and soils in upland areas subject to erosion into the tributaries exceeding sediment cleanup criteria. In other words, recontamination of the Class P stream sediments could only be prevented by removal of all mine and mill wastes and soil exceeding 2 ppm cadmium, 70 ppm lead, and 250 ppm zinc; i.e., the entire Site would require remediation to background concentrations. A removal action of this scope is not technically or economically feasible.

- Re-establishment of habitat to natural conditions after total sediment removal may take scores of years to accomplish.

- Adequate habitat and significant fish populations occur in the Site Class P streams under current conditions. Although RI/FS activities conducted to assess ecologic risks at the Site identified some aquatic invertebrate populations that were thought to be adversely affected, overall fish population diversities and densities were observed to be similar to non-mining effected streams in southwest Missouri.

- The EPA has written a provision into the ROD to conduct additional work at the Site should the remedial action fail to result in the Site streams achieving federal water quality criteria. This work may, if needed, be conducted as an amendment to this ROD, or as a separate operable unit.

The KDHE commented that the remedy presented in the Proposed Plan does not provide the level of effort required to remediate the damage to the environment, and therefore is not protective of the environment in Missouri or Kansas.

The EPA strongly disagrees with the KDHE's assessment of the plan. The EPA has followed the requirements of CERCLA and the NCP and has selected a remedy that, not only complies with the requirements, but is fully protective of both human health and the environment. The EPA believes the KDHE has voiced these concerns due to the fact that sediments will not be removed from the Class P streams at this time. See the EPA's response above with regard to this concern.

The KDHE questioned how long a time period will be required until the Site streams return to "background" conditions.

The EPA cannot accurately answer that question. However, the ROD states the stream monitoring plan will be developed and implemented during the cleanup action. Data generated during the monitoring activities will be assessed during the Five-Year Review process. The EPA has specified that should the action fail to meet the established water criteria at the conclusion of the second Five-Year Review, the technical feasibility of conducting additional work will be assessed, and the EPA may recommend additional action.

The KDHE commented that the EPA did not include sediment cleanup criteria in the Proposed Plan.

In response to this comment, the EPA re-evaluated the need for sediment cleanup criteria. The ROD includes sediment cleanup criteria for the Tributaries to the Class P streams and the delta deposits in the Class P steams at the mouths of the tributaries. These criteria are based on Site background soil concentrations.

The KDHE requested the EPA to provide the volume calculations for sediment removal under this action, as well as the volume of contaminated sediment that will be left in the Class P streams.

The Proposed Plan contains the volume of sediment anticipated to be removed. The EPA has not calculated the total volume of contaminated sediments in the Class P streams. Volume estimates for sediment removal form tributaries and delta deposits will be refined during the design phase of the project, prior to remedial actions. These streams include more than 100 miles of channel including Spring River, and Turkey, Center, Short, and Shoal creeks.

The KDHE questioned if sediment monitoring would be part of the surface water quality monitoring program developed for the Site to assess the effectiveness of the remedial action.

The EPA will rely mainly of surface water quality to assess the effectiveness of the remedial action. However, the EPA anticipates including sediment monitoring in the program to monitor contaminant concentrations during and after remediation.

With respect to the summary in the Proposed Plan, KDHE questioned what ARARs the EPA believes will not be met by the action, and what requirements will be waived. They also suggested that if ARARs could not be met, the EPA should suggest a new remedy.

The KDHE has taken these statements out of context in the Proposed Plan. The text in question is simply stating CERCLA requires that ARARs be met or that a waiver of the ARARs be justified in the case that no reasonable action conducted would be capable of achieving ARARs. The EPA believes that the remedy presented in the Proposed Plan and selected in the ROD will achieve ARARs. The EPA is not proposing a waiver of ARARs as part of the remedy for OU-1.

The ODEQ expressed concern regarding change in the ground water hydrology and resulting effect in Oklahoma as a result of filling numerous mine subsidence pits in Missouri. They ask if the EPA has performed any hydrogeologic modeling on the effect of closing multiple mines.

The EPA has not performed any modeling on the change in ground water conditions resulting from the subaqueous disposal of mine and mill wastes into mine subsidence pits then capping the pits. However, all disposal will take place within the shallow aquifer. Hydrogeologically, the Site is separated from Oklahoma by the Spring River and Shoal Creek. Both of these surface water features are relatively large streams and are anticipated to act as capture zones and hydrologic barriers for shallow ground water in the area. It is not anticipated that filling mine pits in Missouri will have an impact on the water table or recharge to the aquifer in Oklahoma.

The ODEQ cautioned the EPA that studies on deep tilling, as selected in the ROD for transition zone soils, in Oklahoma showed that levels of heavy metals actually increased with the tilling.

In response to this comment, the EPA will assess the effects of deep tilling in areas where this activity will occur. Samples will be collected and analyzed after the tilling to ensure that deep tilling results in metals concentrations below the action level.

The Natural Resource Trustees for Missouri (Trustees) which include the Missouri Department of Natural Resources, Missouri Department of Conservation, and the U.S. Fish and Wildlife Service, commented that no information was provided in the Proposed Plan describing how the footprint of contaminated areas would be addressed after the removal and disposal of the wastes.

The Proposed Plan clearly stated that excavated areas would be graded to promote runoff, and then revegetated. In response to this comment, additional language has been added in the ROD to specify regrading will be conducted to ensure the excavation activities will not cause ponding of water, unless the wastes are in deep depressions and the land owner specifically agrees to the construction of a pond during the removal of the wastes. In the case that all wastes can not be removed for a specific site, the ROD envisions the use of soil capping techniques to cover the wastes in place.

The Trustees question what actions will be conducted by the EPA in the Highway 249 corridor because of the delay in funding by the Missouri Department of Transportation (MDOT) to construct the highway using 600,000 cubic yards of mine wastes for construction fill, as specified in EPA's July 2000 EE/CA.

At this time, the EPA does not anticipate taking any action in the area specified for cleanup by MDOT. The EPA understands that funding for that project is forthcoming, although it may not be available for a few years. The EPA will reassess this position near the end of the remedial action specified in this ROD, and determine the progress of MDOT on their activities. If it appears MDOT will not complete their portion of the cleanup within a reasonable timeframe, the EPA may address the remaining source materials in the highway corridor.

The Trustees stated that barren chat that does not support earthworms because of its toxicity creates a loss of habitat to migratory birds and other wildlife.

The ROD specifies that all source materials exceeding the human health and terrestrial cleanup criteria will be removed and disposed. The cleanup level is based on remedial goals. The EPA remedial actions are to conduct cleanup to protect human health and the environment. The loss of habitat may be an additional damage to the Site. Although it is usually an incidental benefit of the EPA's remedial action, habitat restoration is not the EPA's primary goal for cleanup.

The Trustees commented that the remedial action does not address zinc toxicity to plants from the Site source materials.

The EPA acknowledges this fact. The remedy selected in the ROD was designed to mitigate risks posed from sources at the Site to human health and the environment as a whole. Typically, the EPA selects and designs remedies to be protective of the ecosystem, not just specifically plants.

When selecting assessment ecological endpoints and receptors of concern, there are three criteria to consider: (1) ecological relevance, (2) susceptibility to the contaminants of concern, and (3) relevance to risk management goals. Plant communities are an ecologically relevant receptor because they help sustain the natural structure, function, and biodiversity of the terrestrial ecosystem. However, the susceptibility of plant communities at the Site remains uncertain. Ecological receptors are considered susceptible when they are sensitive to the contaminants to which they are exposed. Although soil concentrations may exceed phytotoxicity reference values, viable plant communities are present at the Site, which indicates that the sensitivity and tolerance of the natural plant communities at the Site are not comparable to laboratory test species.

Finally, plant communities may not represent a receptor that is relevant to the risk management goals for this site. Due to the nature of the impacts to this ecological system, achievable risk management goals are being based on other ecological values, such as higher trophic level terrestrial birds and mammals.

The Trustees commented that the technical impracticability (TI) waiver issued by the EPA for ground water (OU 4) applied only to drinking water and allowed limited ground water remediation as part of subsequent remedies. They stated ground water may need to be remediated to address ecological risk, and that ground water provides the base flow for streams and should be remediated.

The ROD includes actions to address ground water where it can be shown to directly discharge to surface water streams. This is mainly addressed through shaft plugging and treatment of waters discharging from overflowing shafts. The TI waiver provides rational for the EPA's decision to not remediate all contaminated ground water. However, the OU-1 ROD contains engineered actions to specifically mitigate metals leaching to ground water and subsequent discharge to surface water. The EPA believes metals concentration in the base flow in streams will be significantly reduced due to implementation of the actions described in the ROD.

The Trustees commented that 18 inches of agronomic soil cover over disposed wastes is not sufficient from a plant community or habitat perspective, or to prevent burrowing animals from contacting the disposed wastes.

The purpose of the agronomic soil cover is to prevent direct exposure to, and erosion of the disposed wastes. The EPA is proposing to revegetate the covered disposed wastes with native grasses to prevent erosion of the caps, which will provide additional viable habitat. Actions taken pursuant to this ROD will result in the least amount acreage for disposal and capping of waste, thus the least amount of cap area, of any of the identified remedial alternatives. Additionally, the selected remedy will provide for the largest acreage of restored habitat, by removing the wastes from the largest amount of land, of any of the identified alternatives. An 18 inch soil cover is adequate for grass production. With respect to burrowing animals, the EPA believes the occurrence will be insignificant in the Site as a whole to create an unacceptable risk.

The Trustees commented that the Quapaw Tribe in Oklahoma has recently proposed their own water quality standards, which may be different from Missouri's.

The ROD specifies the surface water cleanup criteria as federal water quality standards, which are currently more stringent than Missouri's standards. Additionally, the EPA selected the federal standards since the state of Kansas, as the receiving state for surface water, has adopted the federal standards. If the Quapaw Tribe is authorized by the EPA, Region 6 to establish water quality standards, and should Quapaw standards be established which are more stringent than federal standards, the EPA will consider modifying the ROD based on the more stringent Tribal water quality standards, if it is determined that Quapaw lands receive waters from the Site. However, in general, ARARs for cleanup are set at the time of the ROD.

The Trustees requested that willow or cedar revetments or other natural bank stabilization techniques be use for stream restoration as apposed to stone rip-rap.

The EPA has included language in the ROD to this satisfy this request. The ROD includes a preference for using willows, cedars, and other natural vegetation over stone rip-rap for stream bank stabilization.

The Trustees question what measures will be taken to control the disposal pits during the one year settling period, and what actions will be taken if settling occurs once the pit is closed.

Pits will be surcharged with disposal material during filling and allowed to settle for one year. Erosion controls, such as silt fencing, will be placed around the pits to control runoff during the settling period. After one year, the pit material will be graded to promote proper runoff and capped. Settling after the one year period but before completion of the remedy will be corrected during the remedial action. Settling after the completion of the remedy will be corrected as part of operation and maintenance.

The trustees commented that a more specific ground water monitoring plan needs to be developed to adequately assess short and long-term release of metals.

The EPA has included additional language in the ROD which defines monitoring requirements.

The Trustees strongly recommended against using the Wild Goose pit for subaqueous disposal due to its acidic nature, and further that partial filling may create an attractive nuisance. The MDNR also expressed concerns about the filling of the Wild Goose pit.

The EPA understands this concern and included provisions in the Proposed Plan and ROD for treatability and pilot studies at the Wild Goose pit to assess the feasibility of neutralizing the acid water prior to disposal. The EPA has also included the option, if necessary, to fill the pit completely and eliminate the attractive nuisance problem.

The MDNR commented that the EPA should develop numeric criteria for cleanup of tributary sediments and delta deposits at the mouths of the tributaries in the Class P streams. They suggested the criteria be based on the McDonald sediment criteria or background soil concentrations as an alternative.

The EPA has included numeric criteria in the ROD. These criteria are based on background soil concentrations. The background concentrations are also similar to the McDonald sediment criteria.

The MDNR commented that historical fish tissue samples from the Site streams, as well as ongoing fish sampling data by other agencies, should be used during the development of the Surface Water Monitoring Plan.

The Surface Water Monitoring Plan will be developed during the remedial design phase of the project. The EPA will consider, and include as appropriate, the use of fish tissue data in development of the plan. The EPA will also include the MDNR in development of the plan.

The Missouri Department of Health and Senior Services commented that they understood the EPA would be supporting several local agencies to implement the health ordinance as apposed to one "overarching" authority. They expressed concern on the effectiveness of this approach.

The EPA is proposing to fund the Jasper County Health Department (JCHD) to establish and implement the health ordinance to control residential construction with the Site. The EPA understands from conversations with the JCHD that they will likely work with the various municipalities within the Site to establish cooperative agreements for implementation and enforcement of the ordinance. However, the EPA anticipates that JCHD will be the governing authority for the ordinance.

The JCHD and the Environmental Task Force of Jasper and Newton County (Task Force) commented that costs to conduct the health education and institutional controls activities described in the Proposed Plan were not included in the Plan.

The EPA inadvertently neglected to include cost for the health education and institutional controls activities. A cost of $1,850,000 for a 10 year period for health education and institutional controls was added to the cost estimate in the ROD.

The JCHD and the Task Force commented that the cleanup standards for upland waste piles (specified in the Proposed Plan) is significantly higher than the standards required for residential yards. They stated that this would require continued enforcement of the building restrictions after the OU-1 activities are complete, and would create a financial difficulty (on the county) if the EPA does not plan to fund the ICs in perpetuity.

The EPA agrees with the JCHD and has lowered the cleanup criteria in the ROD for the Site sources from those presented in the Proposed Plan to now be in agreement with the cleanup standards for residential yards.

The Task Force commented that they believe it is essential for the EPA to continue funding health education, and to fund the ICs once implemented, until the cleanup activities at the Site are complete.

The EPA intends to fund both these program until cleanup is complete. The ROD includes costs for these activities.

The Jasper County Superfund Site Coalitions (Coalition) raised questions regarding how waste piles will be identified for removal and how samples will be collected and metals concentrations determined.

Details concerning sample collection methods, waste pile identification methods, and disposal pit identification will be developed during the remedial design. The EPA intends to involve the Coalition in the development of the design and associated work plans for conducting the remedial action. The coalition will have opportunity to provide input and comments on these issues prior to the remedial action.

The Coalition raised concern that waste piles may be left in place after the cleanup, which tested low and were not disposed, but may later be removed by the property owner which could result in contaminated fines remaining in the footprint of the pile.

The EPA will take this possibility into account when developing the remedial action work plans and sampling plans to ensure this situation does not arise. Sample collection methods will be developed to base the waste pile remove on the fine fraction concentration, as well as, underlying soil concentrations.

The Coalition questioned if there will be a need to control access to remediated areas after cleanup is complete, and how that control would be implemented.

The EPA anticipates that access control will not be required in any areas where wastes are removed since the remaining soil will not exceed any health based action levels once the remediation is complete. Direct access control is not required for the disposal areas since the wastes will be capped and direct human contact with the contaminated wastes will be eliminated assuming the caps are not disturbed. However, to ensure that the caps are not disturbed, and the wastes remain in place under the caps, the EPA will work with individual property owners to implement institutional controls on the disposal areas. These controls will most likely be in the form of deed notices and restrictions and would prevent disturbance of the caps. Activities that involve disturbance of the cap, such as excavation, and construction of any buildings on the cap, would be prohibited by the deed restriction.

The Coalition questioned whether there is sufficient mine subsidence pit volume for disposal of the wastes on site considering many of the pits are unacceptable for use in disposal because of proximity to streams or their high quality habitat.

The EPA believes there will be sufficient pit space for disposal, even excluding numerous pits, but the final analysis will be determined during the remedial design. Should the remedial design analysis show an insufficient pit volume, the EPA will likely issue an amendment to the ROD to specify alternative actions to be taken. If required, the alternative action would consist of one of the alternatives, such as soil capping, identified in the FS.

The Coalition questioned if the use of nutrient rich biosolids create a problem in Site surface water, and whether sufficient amounts of biosolids existed to complete the remedial action in a reasonable time frame.

The EPA assessed the question of nutrient runoff to surface water during several biosolids pilot studies at the Site through the collection of surface and ground water samples at the demonstration sites. Water sample analytical data indicated that excessive nutrient runoff or leaching is not a significant problem with biosolid application to land at the rates applied during the studies.

The EPA has re-assessed the volumes of required biosolids presented in the Proposed Plan, and determined that the volumes were indeed excessive. Volumes presented in the plan represent the maximum amount of biosolids that may be required to promote proper plant growth. Actual amounts of biosolids needed to conduct the remedial action will be refined during remedial design. However, biosolid volumes have been revised and reduced in the ROD to more accurately reflect the amount that may be required for the remedial action. Sufficient volumes of biosolids should be available from various sources, including animal wastes and POTWs, to provide the volume needed.

The Coalition commented that additional ground water samples should be collected from the monitoring wells surrounding the Waco demonstration disposal pit.

The EPA will collect additional samples from the Waco wells during the remedial design, and add sample data collected from the wells proposed for installation surrounding the first few disposal pits fillings to the demonstration project database.

The Coalition questioned why the cities within the Site have not adopted the institutional controls for residential development specified in the OU-2/3 ROD and in the OU-1 Proposed Plan.

The Task Force is developing a draft institutional controls ordinance for residential development that will be presented to the Jasper County Commission for their consideration and adoption. To date, cities within the Site and Jasper County have been reluctant to adopt the ordinance due to varying authorities and the financial burden of implementing the ordinance. The EPA has specified in this ROD that it will fund the county to implement a Site wide ordinance.

The Coalition questioned if there was an ordinance in place to prohibit shallow well drilling in the Site.

The MDNR promulgated water well drilling regulations several years ago that prohibits shallow water well installation in contaminated areas of the Site.

The Coalition commented that the EPA should install "alert" signs on all disposal areas to inform the public that the site is a disposal area with underlying contamination.

The EPA does not agree that signs would be permanent or effective, and would likely call unwanted attention to remediate property. The EPA will rely on deed restrictions for disposal properties to protect the public.

The Coalition questioned if Alternatives 2 and 3 in the FS were disqualified since they would not likely achieve a 90 percent reduction in zinc loads needed to comply with federal ALCs in Class P streams, or comply with the terrestrial criteria.

This assessment is correct. Alternatives 2 and 3 were not recommended by the EPA since it is believed they would not result in protection of the environment.

The Coalition question if disposal pits would always be existing pits or if a new pit will be dug.

The EPA will only use existing mine subsidence pits for disposal.

The Coalition asked why some chat and tailings are assumed to not present a risk to human health and the environment.

The EPA has established cleanup action levels based on metals concentrations that were calculated to present a risk to human health and the environment. Some chat and tailings piles simply do not contain metals concentrations above these calculated cleanup criteria.

The Coalitions question the reasoning in the Proposed Plan that truck traffic and dust would be more intense for seven years (under Alternative 4) than Alternative 2 and 3.

Alternative 4 involves excavation and hauling of wastes, while Alternatives 2 and 3 involve capping and treating the wastes in place.

The Coalition commented that the environmental changes (of the remedy) would cause loss of aquatic life by placing waste in subsidence pits and displacing the water.

Some fish may perish while filling the pits. To the maximum extent practicable, the EPA will identify and use low quality fish habitat pits and avoid those with high quality habitat, good water quality, and thriving fish populations.

The Coalition questioned how long chat owners could continue to recycle chat under Alternative 4.

Owners can continue to excavate and sell chat until near the end of the remedial action, at which point all chat exceeding the cleanup criteria will be disposed in accordance with the selected remedy.

The Coalition commented that in the past, the EPA opposed placing mine waste in mine subsidence pits, and questions if this position changed based on recent research.

This is correct. Until recent years, the EPA advised against placing mine wastes in pits for fear of exacerbating ground water contamination. Recent studies now show that proper subaqueous disposal will not significantly increase metals contamination in ground water, and may over the long term, actually improve conditions by closing surface openings that allow highly oxygenated water in recharge to ground water though mine voids.

One citizen questioned if he would receive proceeds from the sale of what is removed from his property. He asked if vertical shafts would be capped

The ROD does not include any EPA sale of chat. The EPA will not compensate property owners for wastes removed for disposal. Only large mine subsidence pits will be filled during the cleanup action. Vertical mine shaft closure is not considered a remedial action to protect human health and the environment from the release of hazardous substances. Vertical shafts are considered to be a "physical" hazard, which the EPA does not respond to.

The following are significant comments received from citizens verbally during the public meeting. All comments and questions during the public meeting can be reviewed in the transcript of that meeting, located in the Administrative Record.

Concern was voiced about the contamination on "smelter hill" and whether the EPA would address this area.

Smelter hill is the area in and around the Eagle-Picher smelter facility in northwest Joplin. During the public meeting, the EPA explained that there is contaminated soil and mine waste in the area north of the Eagle-Pitcher facility that would be addressed by this action. The contamination located directly on the Eagle-Picher facility property is being addressed through actions by Eagle-Picher under the oversight of the MDNR.

Will the EPA monitor the effectiveness of the biosolids application to excavated areas to assess the effectiveness at growing plants over the long term?

The EPA will assess the effectiveness of the remedy every five years. If the excavated areas are not sustaining plant growth, the EPA will conduct additional work to remedy the situation.

What are the priorities for addressing waste piles for cleanup?

The EPA will start the cleanup in the areas that are highly populated, such as the areas around Webb City, Carterville, and Duenweg, or north of the Eagle-Picher smelter in Joplin. Once these areas are remediated, the next priority will be waste piles that are contributing to stream contamination. The final priority will be the remaining piles that create terrestrial risk and future human health risk.

Can land owners sell chat from their property?

The EPA encourages land owners to remove and sell off the chat on their properties, but cautions that chat should only be used in situations that encapsulate the chat, such as asphalt. The EPA recommends only limited uses for chat in the 2003 Fact Sheet on use of mine waste, which is included in the Administrative Record.

Will property owners be compensated for chat taken off their property during the cleanup, and will they be compensated for their land that is tied up in a disposal repository so they can no longer use that part of their land?

The EPA is conducting the cleanup to mitigate risks to human health and the environment. Owners of chat will not be compensated for the cleanup of the hazardous materials on their property. Owners will be given ample time during the remediation project to remove and sell chat before ultimate disposal of remaining chat is required. Neither will landowners be compensated for portions of their property used for disposal or repositories. Landowners will have access to the capped disposal pits, and some limited use, such as grazing, will be allowed.

Has a dye study been conducted to determine what waters of the state may be impacted by waste disposal?

The MDNR conducted a dye study associated with the subaqueous disposal study near the Waco DA. Results of that study were inconclusive with respect to ground water flow and hydrologic conductivity between the mine pit and ground water. The EPA is not planning additional dye studies. However, the EPA will install monitoring wells around the first few pits used for disposal of wastes to further assess the connection of mine pit water to ground water.

Will the EPA use local contractors to conduct the cleanup work?

The EPA has not yet determined which type of contracting vehicle will be used to conduct the cleanup of OU-1. However, the EPA will strive to use local labor to the greatest extent possible.

Where does the water in the pits go when it is displaced from the pit during filling? Is it collected and treated?

The subaqueous demonstration project in Waco indicated the water in the pits rise during the day while wastes are being pushed into the pits, but then subsides overnight to static conditions. Once the pit in nearly full, the water tends to overflow the pit to the ground surface. In this case, water will be directed into areas where the least impact will be created, and efforts will be made to keep the flow from entering steams. Water overflowing the pits will not be treated. Generally, the metals concentrations in pit water is low and should not cause any negative impacts to surface soils, but will not be discharged to streams. Ideally, the overflowing water will be channeled to areas where it can evaporate. To the extent any water is discharged to streams, it will be in compliance with action specific ARARs.